CHALLENGER 1

TANK CRAFT

BRITISH MAIN BATTLE TANK OF THE GULF WAR

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IFOR
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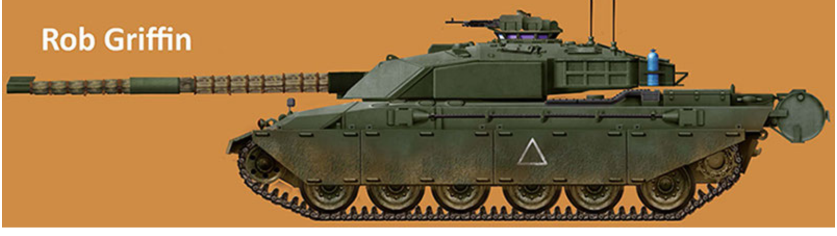
65KC35

Rob Griffin



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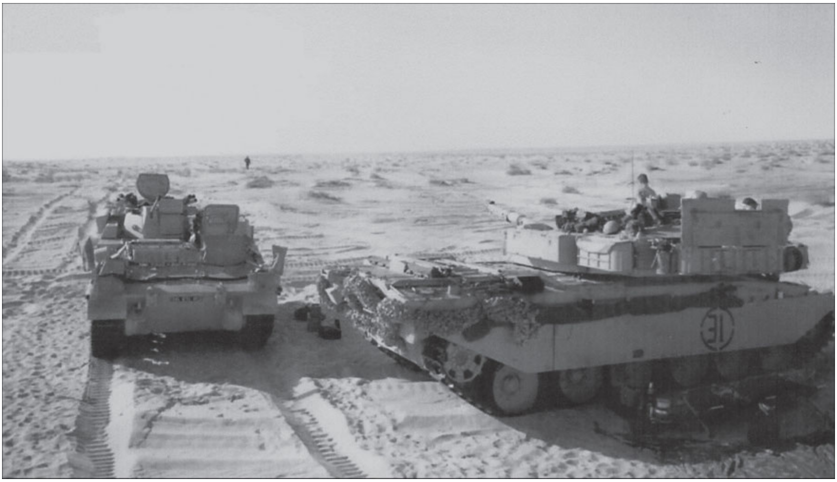

From the looks of things this Challenger is about to be worked on by the REME, as can be evidenced by the Warrior REME repair vehicle parked alongside it. (Grahame Muir)

TankCraft 21

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Rob Griffin

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Front cover. Top: 1/35 Scale Tamiya Challenger 1 Mk 3, British Royal Armoured Corps, IFOR. (Brian Richardson). Centre left: A typical Challenger on exercise. (Mike Seymour) Centre middle: A very good outline of the Challenger 1 rear bin lid. (Neil Palmer). Centre right: Gulf War Challenger, the rods running across the tank are fitted into brackets located on the hull, to ease the task of putting up the camouflage net. (Neil Palmer) Profile illustration: Challenger 1 Mk 1. (David Bocquelet Tank Encyclopedia)

INTRODUCTION

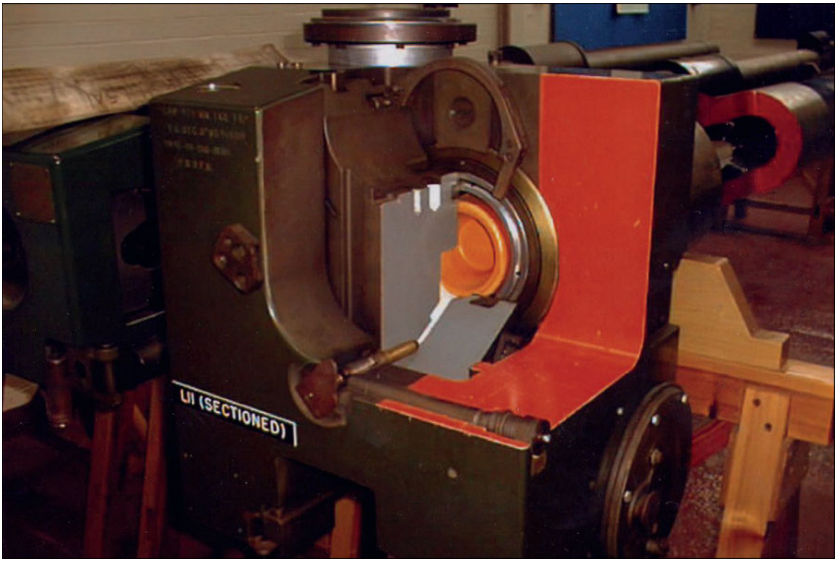
If you were to ask the man in the street how long it takes to design and produce a brand new main battle tank, his answer would probably be far wide of the mark, mostly because he sees the products he uses constantly changing, such as a new mobile phone every year. To those in the know, however, the truth for armoured vehicles is vastly different. It is not a case of a committee sitting down one day and saying 'well our tanks are nearly at the end of their life let's design a new one' all agree and very soon that country has a brand new fleet of tanks. If it was only like that life would be simple. There are so many factors that have to be taken into account such as cost, how many, what role, what equipment and constant design changes. These are the normal restraints regardless of whether you are creating a tank, warship or fighter plane, also on top of all this there is the political interference. So many promising projects have fallen foul of politicians interfering in things they do not really understand. Coupled with that are world events, which are relevant to the story of Challenger.

The United Kingdom has an uncanny habit of creating world-class equipment, basking in the glory, then losing its place as number one, due to many reasons. The tale of tank design and development is one such example. Britain invented the tank during the First World War to help break the deadlock of trench warfare, which it did very successfully. But come peace, while other nations took the idea and improved on it, notably Germany, the British succumbed to the wishes of the old school who wanted to see the mounted cavalry return, and the tank, while good, was only a stop-gap weapon. Sadly those outdated warriors won the day and the Tank Corps had to fight hard for its very existence. This led to British tank crews entering the Second World War at a great disadvantage against the German armour, a situation that was to cause deaths that could have been spared if development had been allowed to proceed in the interwar years. This sad state of affairs was never fully rectified throughout the war and the Allies won by sheer numbers.

However, lessons had been learned which would produce what many consider to be the best British tank design, the A41, which became the Centurion. Six of these were built right at the end of 1945 and were sent to Germany for evaluation under the Operation Sentry programme. For the first time the British were building to the three main parameters that a tank design must conform to, these are: firepower, protection and mobility. There is no hard and fast rule for the order these come in, more a national requirement, for example the British use firepower, protection and mobility, whilst the Germans went for firepower, mobility and protection. Centurion went on to be built and exported to many countries, the most prolific user and convertor of these being the Israeli Defence Forces (IDF). The battles that Centurion fought during the Suez Crisis of 1965, the Six-Day War of 1968 and the 1982 Lebanon War are the stuff of legends.

However, even legends cannot soldier on indefinitely and a replacement had to be found, and here again the British seemed to stumble, for it would have been simple to use modern technology and inventions based on the proven success of Centurion to design a new tank. But again politics came into the equation and ideas such as one-man and two-man tanks were actually suggested and considered, these really were a hark back to the days of the Le Martel tankettes in the inter-war period. Fortunately wiser heads prevailed and eventually the new tank, which was to be known as Chieftain was born. The British had risen to the occasion and actually produced what could have been a world-class design, incorporating many new features, such as having the driver in a reclining position when closed down allowing the height of the tank to be significantly reduced, and the use of split (bagged) ammunition. Conqueror had used split ammunition but it was contained in a brass case, whereas that of Chieftain was in a combustible bag, which meant apart from the .625mm vent tube igniter there was no empty brass case to be ejected into the turret.

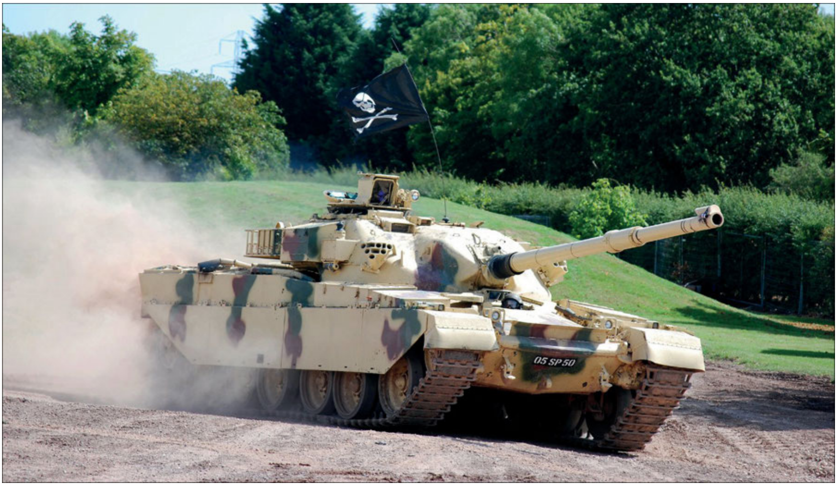
The driver’s task was made easier through the use of a foot-operated auto change, thus relieving him of the manual use of a clutch. The main feature was the use of the 120mm tank gun firing HESH (High Explosive Squash Head), APDS (Armour-Piercing Discarding Sabot) and smoke rounds, along with practice natures for these, and some other rounds which were developed but never issued. To assist the commander in estimating the range, the British had eschewed the American preference of installing a rangefinder, as it was felt it took too much training to use accurately and used too much space. Their solution was simple: a .50-cal Browning machine gun would be modified to fit three spotting rounds at a time, and depending on the nature of the ammunition used the fall of this round would give an indication of the range. The system worked well and was improved later with longer-range ammunition, and eventually with various marks of tank laser sights. The armour on Chieftain at the time was considered to be the best in the West. Although it was hard to compare to the Soviet vehicles at the time, the Iran–Iraq War did allow the effects of Russian-built T-72s to be seen on Chieftains, and this led to an up-armour package being fitted to the turret front. Chieftain was constantly being upgraded but it soon became a case of finding the space to bolt bits onto. The one thing that was never really sorted out was the power pack: these problems led to the loss of many sales abroad. The pack was a vertically opposed diesel engine built by Leyland motors and it was a constant source of breakdowns throughout its life, although in Chieftain's last days things did improve. The sad part is Rolls-Royce asked the government to wait for two years as they were finishing off the design for a 12-cylinder V engine that would be suitable for Chieftain. The government, however, wanted the 120mm gun in frontline service as soon as possible, hampering potential sales.



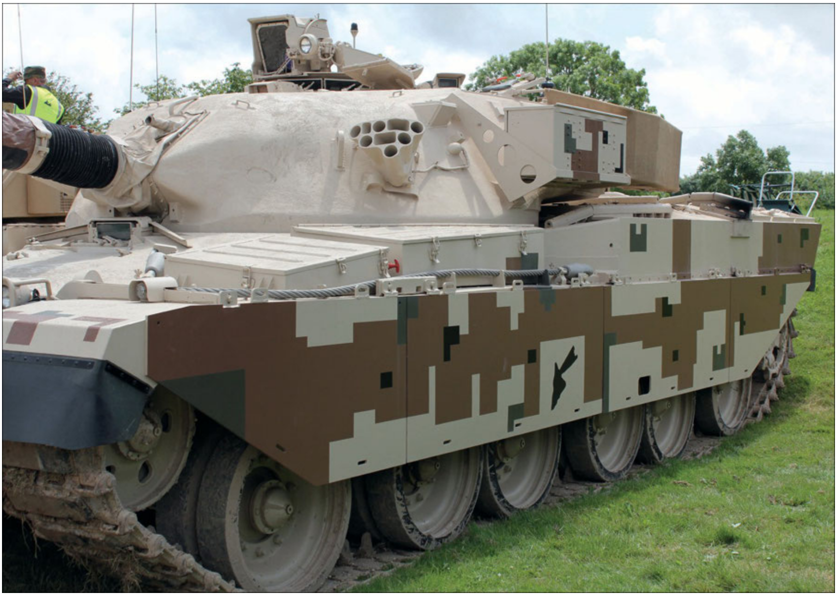
A section through the breech of an L11 120mm gun as fitted to Challenger 1. The orange object is the base of the bagged charge, the channel below it is the path the flame from the .625mm vent tube follows to ignite the charge. (Rob Griffin)

However the time had come that a replacement was required and this had in fact been going on for many years, the future hope was based on what was called the MBT80, this was going to be a superlative tank, with such features as advanced night vision, add-on armour packs, a reliable engine and another new main armament which see-sawed between 105mm through 110mm back to 120mm. In the end the only major component actually built was the commander's combined sight, and according to one source 'they were the best optics he had ever seen'. No hulls or turrets were built, although test beds for ideas are still around, but as no final plans were ever drawn nothing could be built.

This left the British in a fix, Chieftain was now clearly showing its age and needed to be replaced and quickly. World events now took a hand in the story. The biggest purchaser of Chieftain had been the Shah of Iran, who had already bought some 707 gun tanks plus recovery and bridge layers, and later an improved version which came to be known as Shir 1 were ordered. These consisted of a 1,200bhp power pack which would have been used in the MBT80, along with suspension improvements, although this was not to be Hydrogas, which one would have expected given the higher mobility of the vehicle. However, while this order was being built the Iranians issued the specification for another tank which would be a new build and would incorporate the use of Chobham armour developed by the British in the 1960s. The order would be in excess of 1,250 tanks and would be known as Shir 2. This was a major coup for the British tank industry and for the country. The Royal Ordnance factory at Leeds was preparing all the items needed so that full mass production of both versions could begin. However, the Iranian Revolution deposed the Shah and placed the Ayatollah Khomeini in power. By 6 February the British ambassador had been informed that all military contracts with Britain were now cancelled. This left the country with at least two stockpiles for new tanks that had just had their orders cancelled. Luckily the Jordanian government expressed a desire to purchase 274 Shir 1 tanks which were to be renamed Khalid, which proved a bit of a face saver. However, there was still the issue of Chieftain's replacement. It was suggested that the British Army could take on the contract for the Shir 2 thereby producing a new tank, but this was discounted by the government as the MBT80 was still the preferred project. It was the opinion of many that Shir 2 was just an upgraded Chieftain and MBT80 was the way to go.



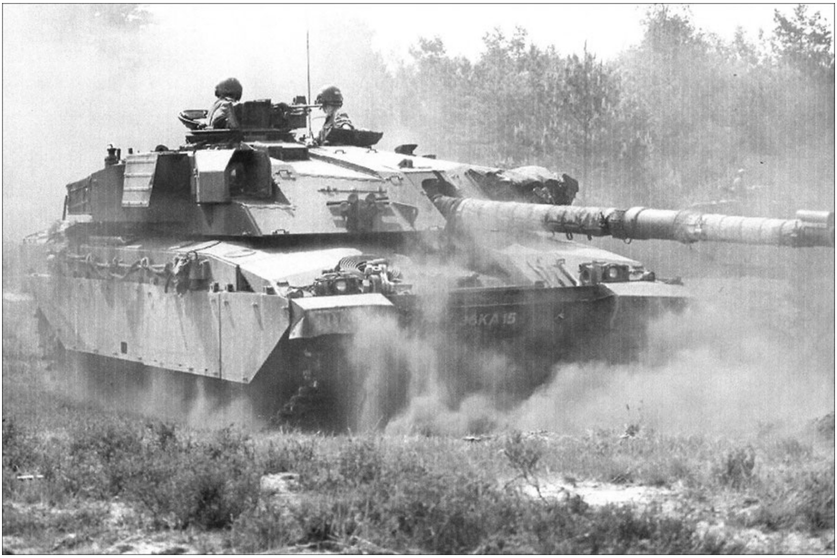
The best of both worlds, Chieftain front and Challenger rear, which means it can only be a Khalid, in this case sporting the Jordanian camouflage pattern. (Stephen Reed)



Shir 1/ Khalid sporting its Jordanian digital camouflage, many say this *is how Chieftain should have ended up. (Harvey Blackruth)*

Meanwhile seven prototypes had been built and testing commenced, equipped with 120mm gun, Chobham armour and Rolls-Royce diesel power pack, Shir 2 was an attractive proposition. The government was now in a quandary: with MBT80 cancelled, should it allow Chieftain to struggle on, while yet another new tank was designed, or, as was seriously mooted by senior staff in the Royal Armoured Corps, buy either the German Leopard or the United States M1. This of course brought cries of horror and is an illustration of the comment at the beginning. However, the government announced on 14 July 1980 that the Shir 2 project would be used to create a new MBT for the British Army and would be known as Challenger. This name was picked after the RAC held a competition for a new name, and 243 Challengers were purchased, but in yet another cobble the whole Chieftain fleet was not replaced, so the RAC had the problem of two different tanks serving together, causing logistic nightmares that were not solved until the decision was made to replace the entire fleet with a new tank: Challenger 2.

This then is how the muddled birth of Challenger came about. It produced a stopgap for the British, and although it would be mired in controversy after its dismal performance in the Canadian Army Gunnery competition, it showed it was a fighting tank when it finally went to war in the desert it had originally been designed for.



This Challenger is reversing, which can be one of the most difficult movements to make, but at least this time the commander and operator are able to stand up and see where they are going. Doing this closed-down with only the commander's periscopes to see from is a nightmare. (Les Critchlow)

Challenger 1 in Detail

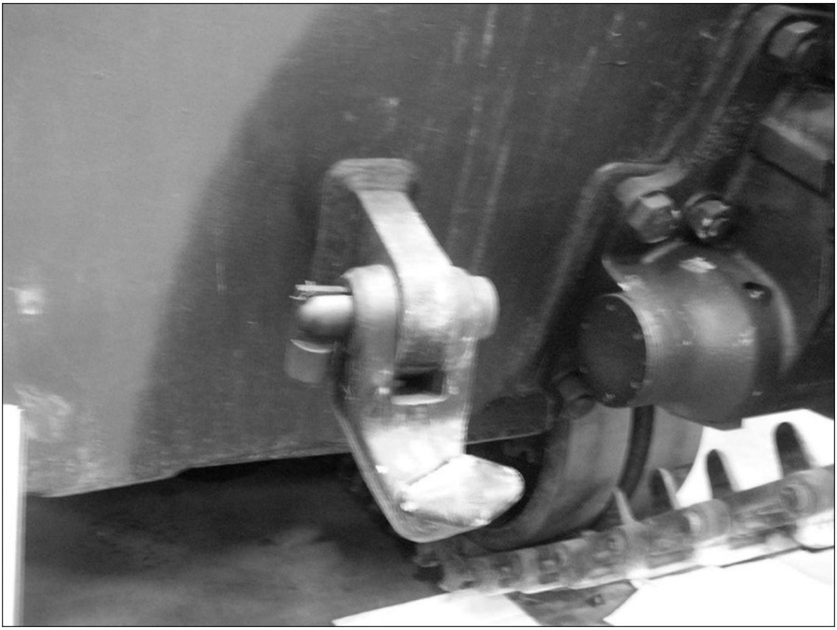
One of the problems that people find when trying to identify the Challenger marks is the fact that they all look very similar. Even Chieftain, which ran to 11 marks, only had five separate new builds, with bits added on here and there.

The truth is that apart from the prototypes and very early production models they all look the same. Visual differences mostly require the viewer to clamber on the tank to see the changes, which could be as subtle as a different design for the engine deck torsion bar or the armoured charge bins inside the turret.

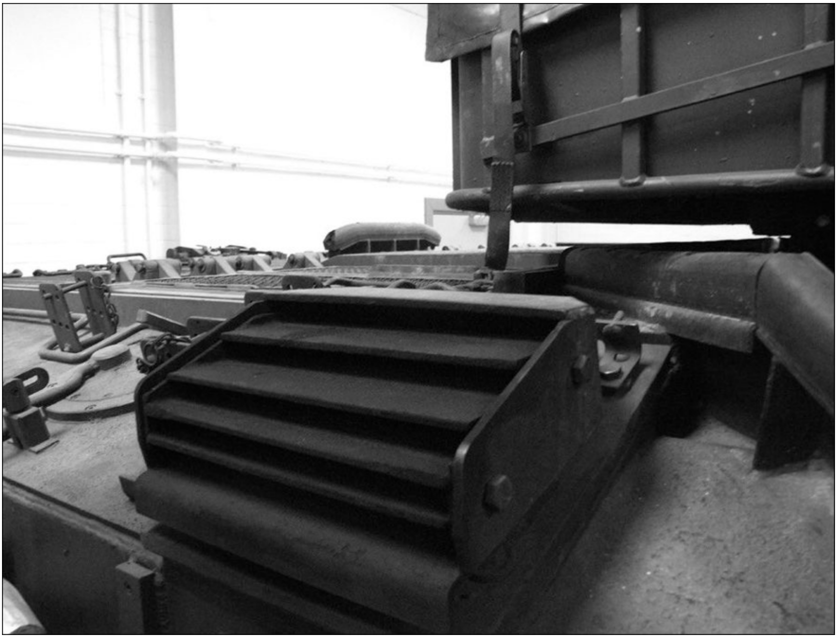
One way of discerning a prototype is by the raised glacis present on all prototypes, early marks and Shir prototypes. This was removed in the mid-1980s on most but not all service tanks. (This is something that would have to be done to make an accurate model from plastic kits.)

Suffice it to say that for general observation all versions look the same. What sometimes clouds the issue is the British love of bolting extra ‘acquired’ bits on, such as the long stowage bins from Chieftains.

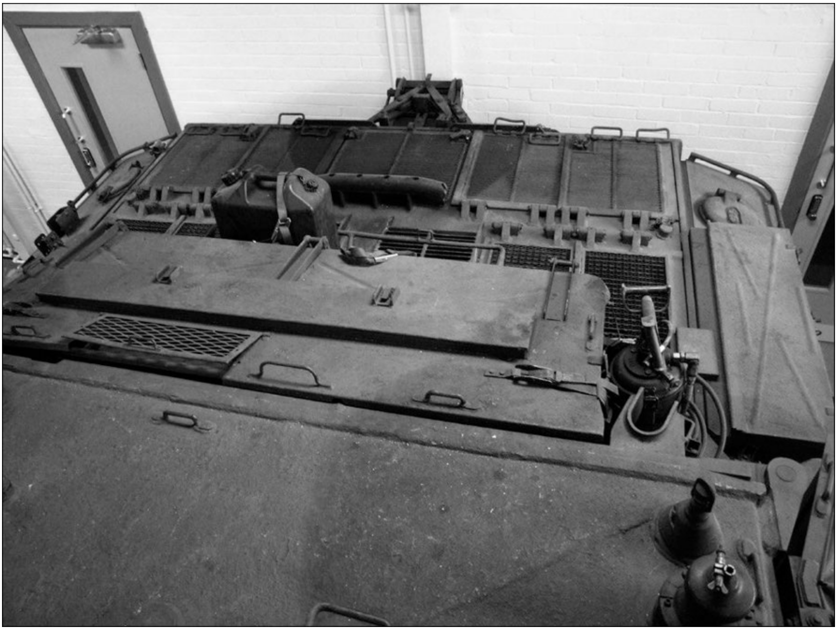
The hull of Challenger consists of welded plates, creating a simple box shape. The hull bottom has a slight V shape to it, which helps deflect blast from mines, and the hull sides are sloped as is the hull rear and the front area, known as the upper and lower glacis plate. Sloping of the armour plate gives great thickness without actually having to make the plate thicker. Sloped armour means that a projectile trying to penetrate has further to travel. The hull is divided into three main parts, the driver’s compartment at the front of the tank, the centre, known as the fighting compartment, and the engine compartment.



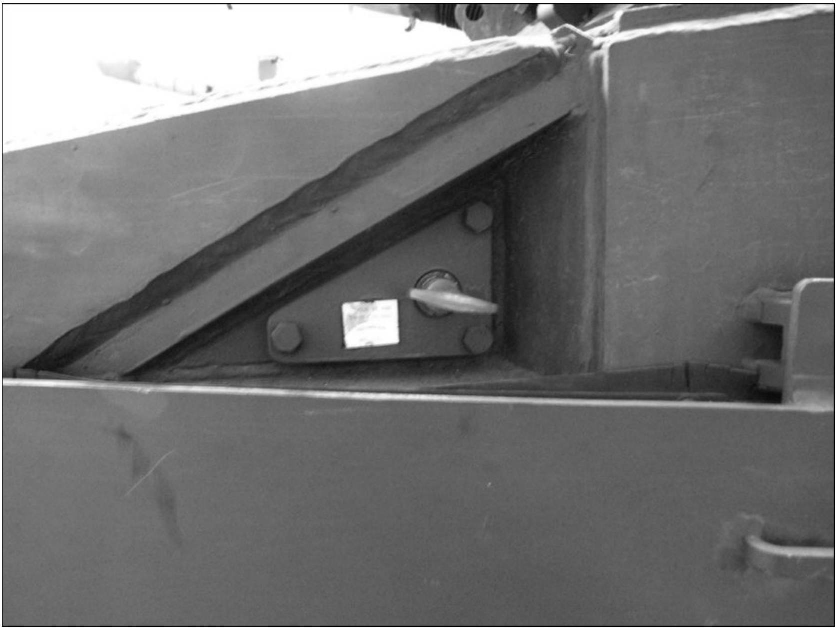
The simple securing arrangement that retains the pin through the towing bollard. (Rob Griffin)



Useful close-up of the righthand exhaust outlet. During the Gulf War various add-ons were produced to try and reduce the Infra-Red (IR) signature from the exhaust. (Rob Griffin)



A good view of the rear turret bin showing its correct shape. The object to the right is the high-pressure grease gun used during maintenance. (Rob Griffin)

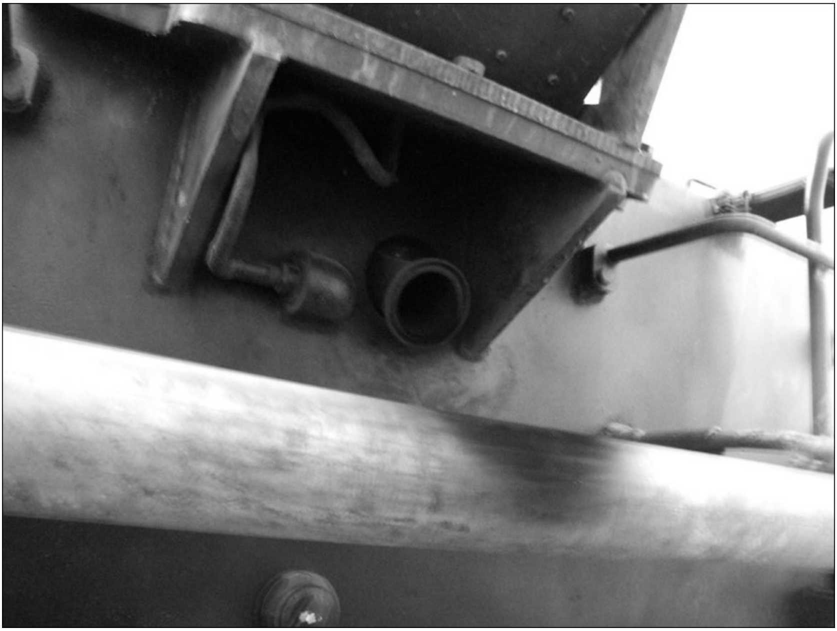


An often overlooked feature is the detail associated with the fire extinguisher handles located left and right front of the vehicle. (Rob Griffin)

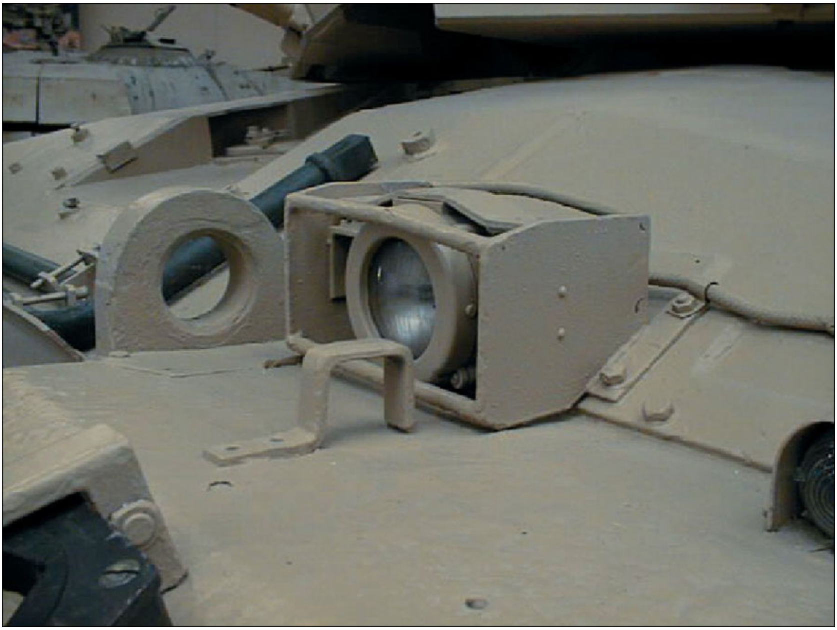
The driver's compartment, as the name suggests, is the location for the driver and all his associated controls, which we look at later, and the fighting compartment is topped off by the turret, and contains all the ammunition and weapons to enable the tank to carry out is role. The engine compartment contains what is possibly, apart from the Chobham armour, Challenger's most important advantage over its predecessor, the Rolls-Royce (later Perkins) CV12 diesel engine. This gave the Challenger far more power and reliability over the troublesome L60 of the Chieftain. It is of the power pack design, which means the cooling system and engine is all one item and can be removed from the vehicle as a single unit, thus reducing time taken to repair. Coupled to the pack is a David Brown TN37 automatic gearbox, giving automatic control over gear changes and thus making the driver's life a little easier. Also located in the engine compartment is the auxiliary generator. This is fitted so that the tank can have electric power when stationary for long periods, that is, when it is desirable to switch the main engine off for fuel economy and tactical reasons.

The hull and turret are protected by the addition of the now-familiar Chobham armour, composite ceramic vehicle armour, developed in the late 1960s at the Tank Research Centre at Chobham in Surrey. It has had several name changes, the most common alternative being Burlington. The frustrating thing about the United Kingdom's development of this armour was that although trials had been carried out to establish whether it could be carried by the Chieftain, the first tanks to actually carry it would be the 1,225 Shir tanks produced for the Shah of Iran. The feeling in the regiments was one of muted anger when it was announced by Roy Mason MP, the defence secretary at the time. However, as the deal collapsed with the fall of the Shah it was left to the Challenger to become the first Chobham-armoured tank in production. The design of the armour is way outside the scope of this book, and even today little is known of it except that it is quite different to the original. The armour covers the frontal upper glacis plate and the frontal areas of the turret, giving unrivalled protection.

Engine decks showing how only certain decks sport the mesh protection over them. (Rob Griffin)



Rear view showing the GUE exhaust (auxiliary engine for providing electrical power). (Rob Griffin)



headlight assembly, showing routing of the cable. (Rob Griffin)

This was once located on the training area at Bordon heath as used by the REME for their vehicle recovery training. (Rob Griffin)

Onto the side of the hull is bolted another step forward in British tank design, for at long last the rugged and dependable Horstmann suspension which was developed during the Second World War was replaced by six Hydrogas suspension units on either side.

These give a much smoother ride which in turn aids firing on the move and also crew comfort. As each unit is a separate item it is easier to replace in the event of damage. The tank runs on single-pin track, similar to the Chieftain but wider. At the front an adjustable track tensioner is fitted to the idler wheel that allows the crew to tighten or slacken the track as required.

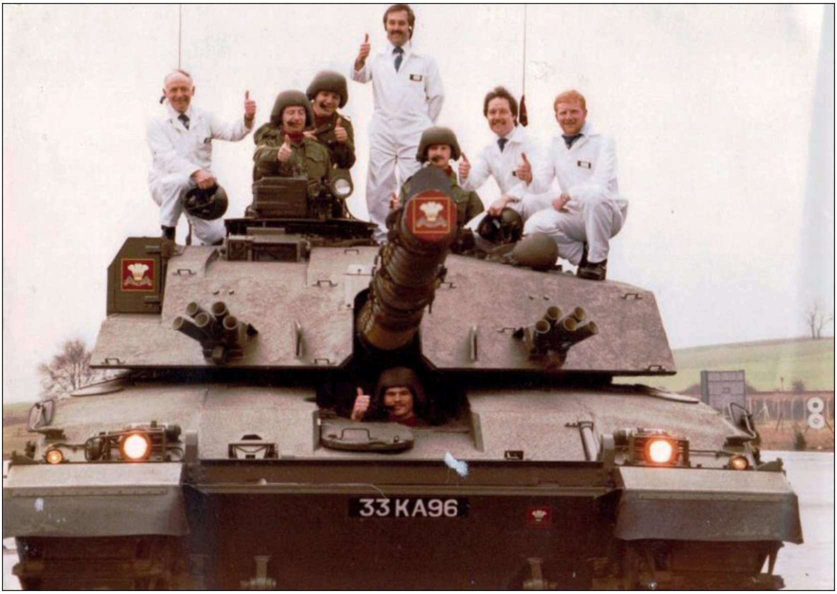
Power from the TN37 gearbox is directed to the sprockets which drive the tracks.

The suspension and road wheels are to an extent protected by the side plates, which are known either as bazooka plates or skirting plates. On the Challenger these are made from aluminium, but on Chieftain they were originally from steel plate before being replaced by similar aluminium ones. Various tools are located around the hull, with heavy towing gear on the rear plate; Challenger does not have as many stowage bins as Chieftain did, hence the use of external stowage.

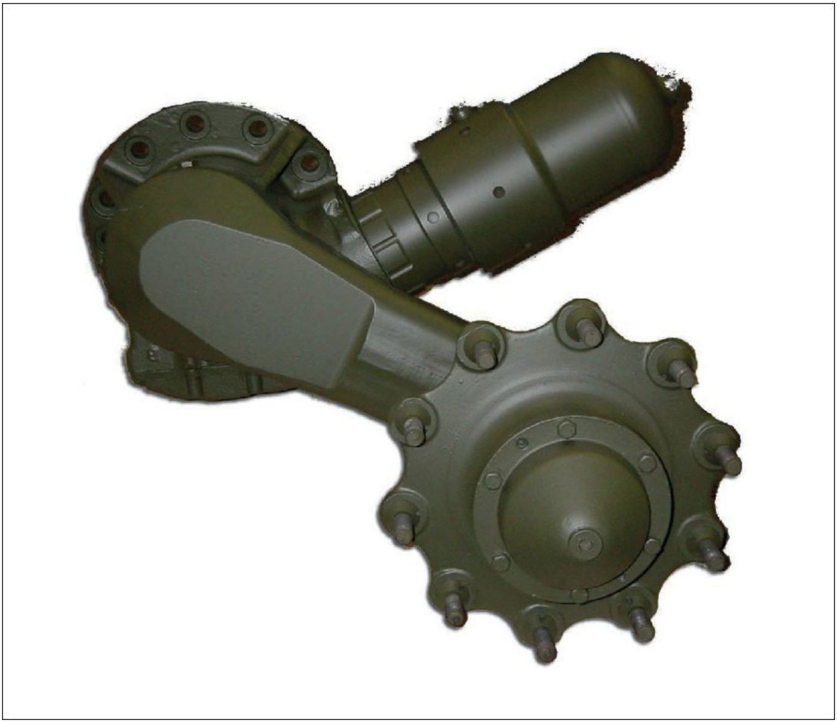
The turret is a casting, similar in shape to that of Chieftain, but this would not be recognized as the turret front is covered with the Chobham armour panels which give the Challenger its unique shape.

The shape had been developed over the years by research departments experimenting with different panels, in fact, even Conqueror in the 1950s and 1960s had trial up-armouring added to several vehicles, giving it that long sloping look that has become the standard shape. MBT80 was to have similar armour fitted but only in times of conflict, as was a proposed Chieftain Mk 5/2. The 120mm has no external mantlet, just a dust cover to stop the ingress of dirt and moisture.

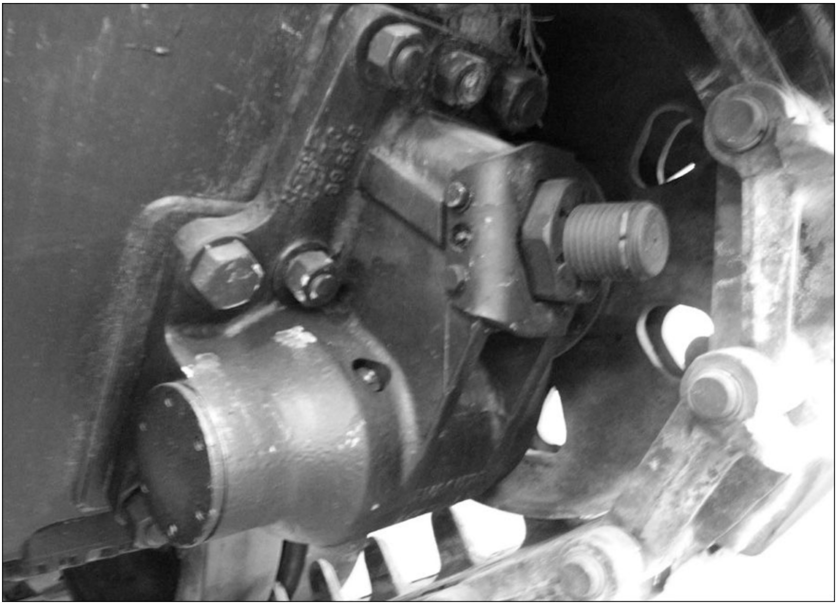
On either side of the frontal armour multi-barrelled smoke dischargers are located, which can fire a total of ten smoke grenades, designed for use in an emergency to enable the tank to extricate itself from danger. The loader is equipped with two spring-loaded hatches and the commander has a single hatch on his cupola to allow access to the inside of the turret. Around the cupola wipers are fitted for each periscope and these have a washer system fitted to them. The No. 37 sight is protected by a light-armoured cover with a door to the front; this also has a wiper and washer system fitted. The cupola carries the commander's 7.62mm GPMG and a 100w spotlight.



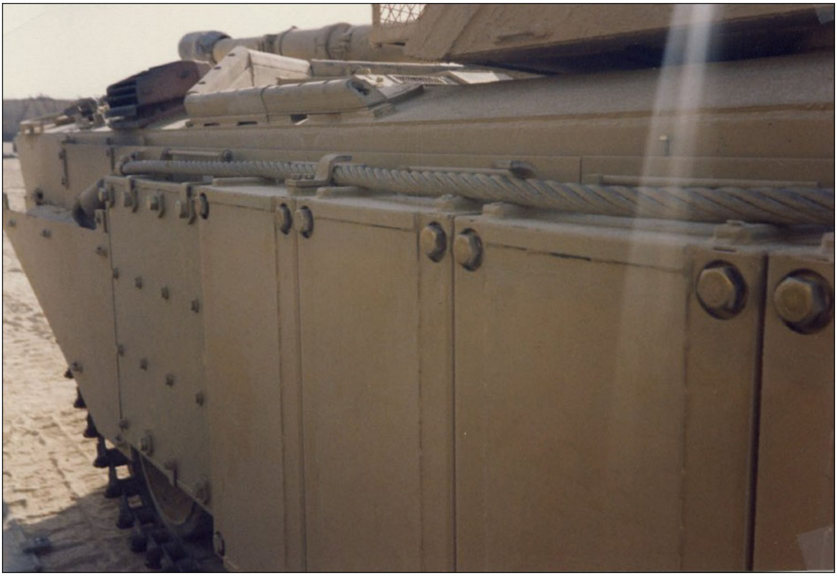
The first Challenger 1 to enter service with its enthusiastic crew from the Royal Hussars, the first regiment to be issued with it, the picture is at the former tank production at Barnbow in Leeds. (Pete Plummer)



One of the main features of Challenger as a superior ride to its predecessor Chieftain was the abandonment of the spring-pack-based Horstmann suspension. It was replaced with the Hydrogas unit seen here. Another advantage is that each unit is individual, so it is easier to replace in case of failure or damage. (Courtesy of Horstmann Defence)



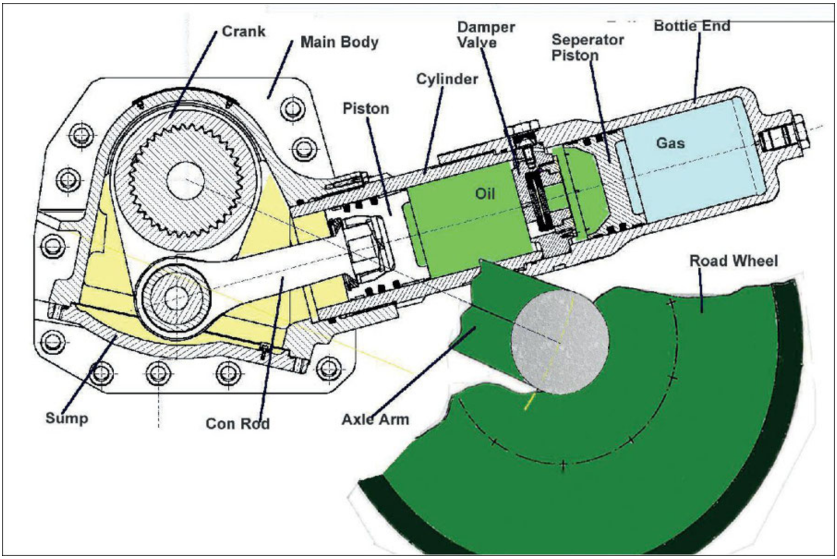
The track adjuster, similar to that fitted to the Chieftain, a thankless task involving a large ratchet-type spanner fitted over the large nut, then adjusting until the track was tight or slackened off as required. It could take two crew members to jump on it to move it. (Rob Griffin)



Close-up of the mounting of the rear add-on armour on the sides of the Challenger for Operation Granby. (Dennis Lunn)

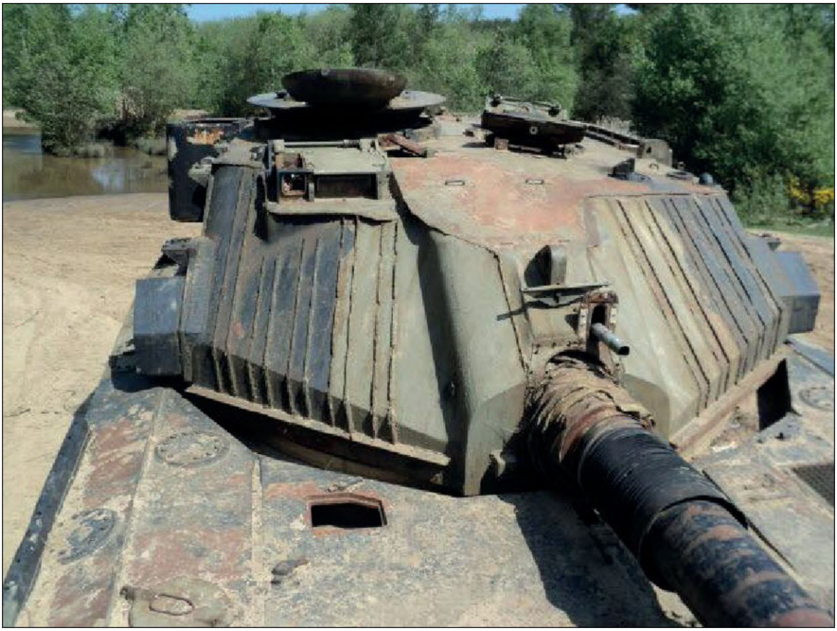
Various hatches in the turret roof allow access to the power-laying electronics or the turret radio batteries and an internal drinking water tank. Located at the rear of the turret is a large bin for personal stowage (this is often incorrectly modelled on kits of the Challenger).

Located on the right of the turret is the Thermal Imaging Equipment consisting of the compressor and the actual camera box. Both are mounted in light-armour boxes fixed to the turret wall. The camera is attached to the main gun and follows it in elevation and depression. The fitting of this equipment really does bring home the concept of the 24-hour battlefield. The early production models and prototypes did not have TOGS (Thermal Observation and Gunnery Sight) fitted as it was not ready so the tanks were produced in the 'fitted for but not with' mode. This led to the frontal face of the turret being full width without the cut-out for the TOGS box. Once the TOGS was available the frontal plate was altered to allow the fitting of the TOGS and the familiar shape became apparent, although the prototypes were mostly held by training units and REME (Royal Electrical and Mechanical Engineers) for familiarization of the vehicle to the trainees.

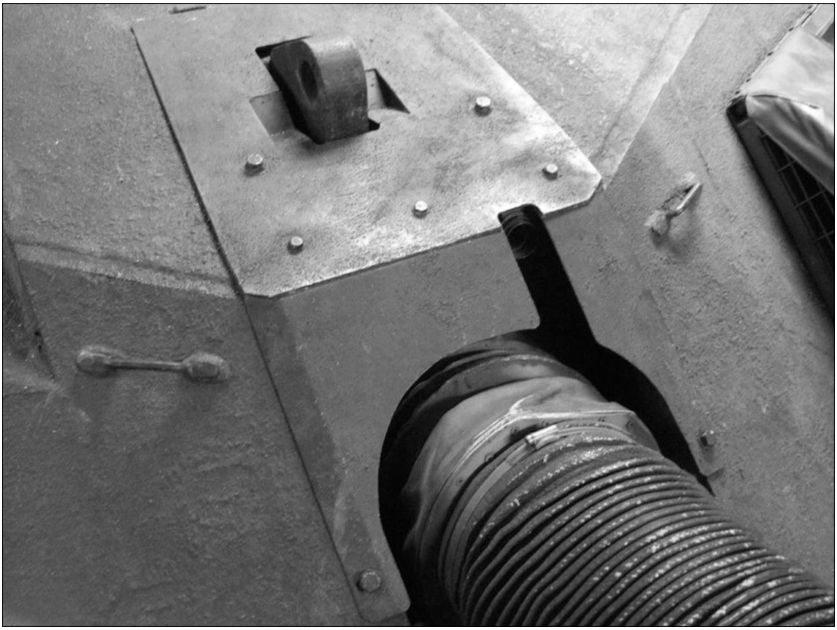


An excellent cut-away showing the simplicity of the operation of a Hydrogas unit as fitted to Challenger. (Courtesy of Horstmann Defence)

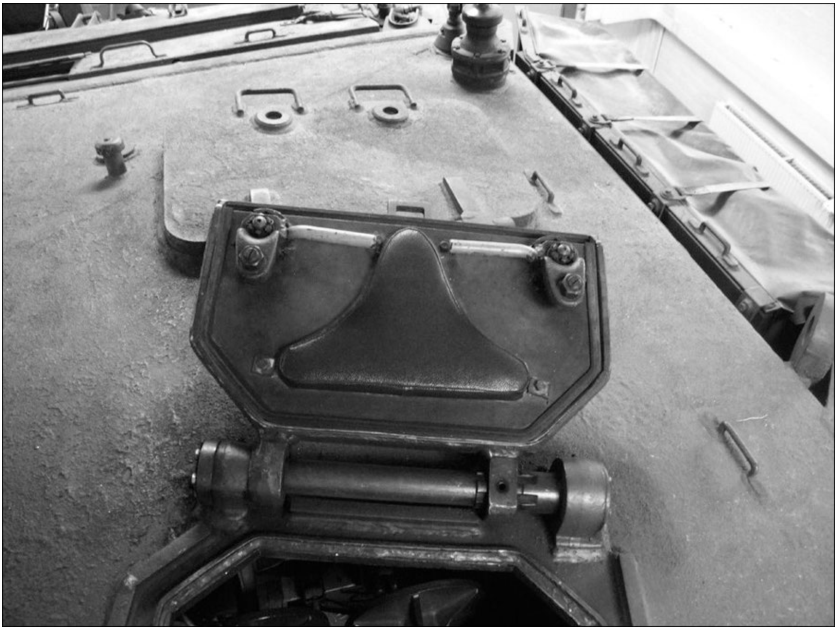
As we have seen, Challenger follows the conventional layout for Western tanks in that it has a four-man crew, the notable exception to this being the French Leclerc tank, with its three-man crew. It is felt for many reasons that a four-man crew does allow the workload to be divided up more equally. For example if you were in a troop leader's Challenger and you have just pulled up into a wooded hide for a night, the jobs that will need doing in no particular order would be: track discipline which involves covering the tracks made entering the wood; cooking a meal; cleaning weapons; making arrangements for sleeping; track maintenance; camouflage; and troop leader's briefing with the squadron leader – this will inevitably mean the troop officer being away, thus the workload falls to the remaining three crew members. A threeman crew would be even more stretched for work. Four men also allows for a hand in the turret to rectify any faults with the weapons, something an autoloader can't do.



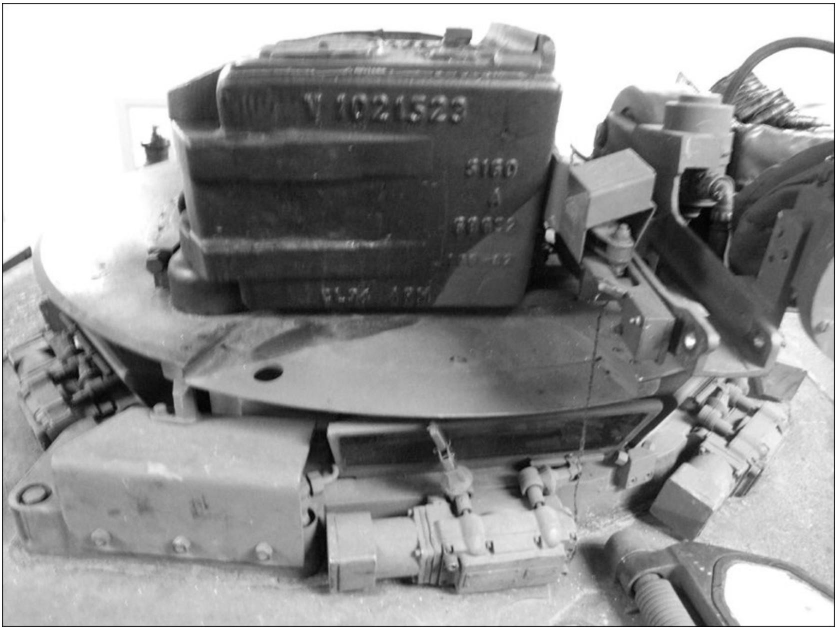
A good view of how the turret casting can be seen to have lineage to Chieftain, also the marks where the add-on armour would have been. (Terry Taylor)



The image shows the turret area directly above the gun. Notice the bellows which is secured to the rear of the gun, fitting over the thermal sleeve at the front and to the mantlet cover at the rear. (Rob Griffin)

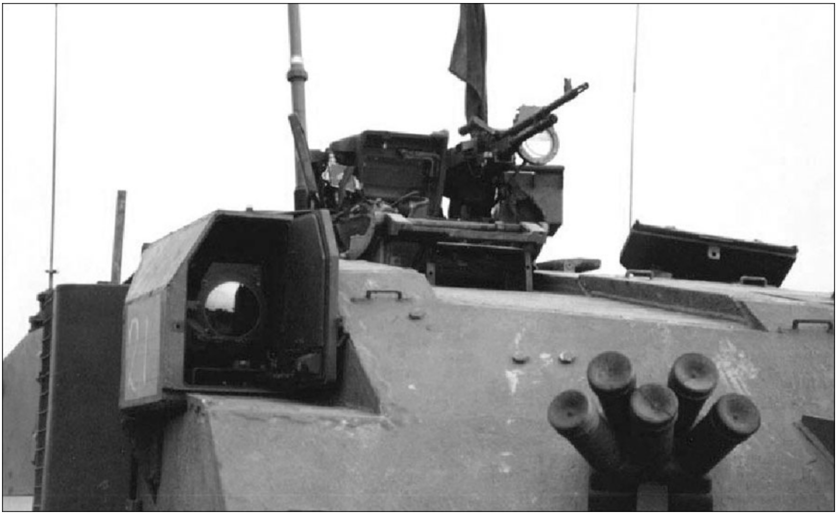


The rear of the loader's two hatches, showing the two locking hatches and the minimal bump protection pad in the centre. (Rob Griffin)

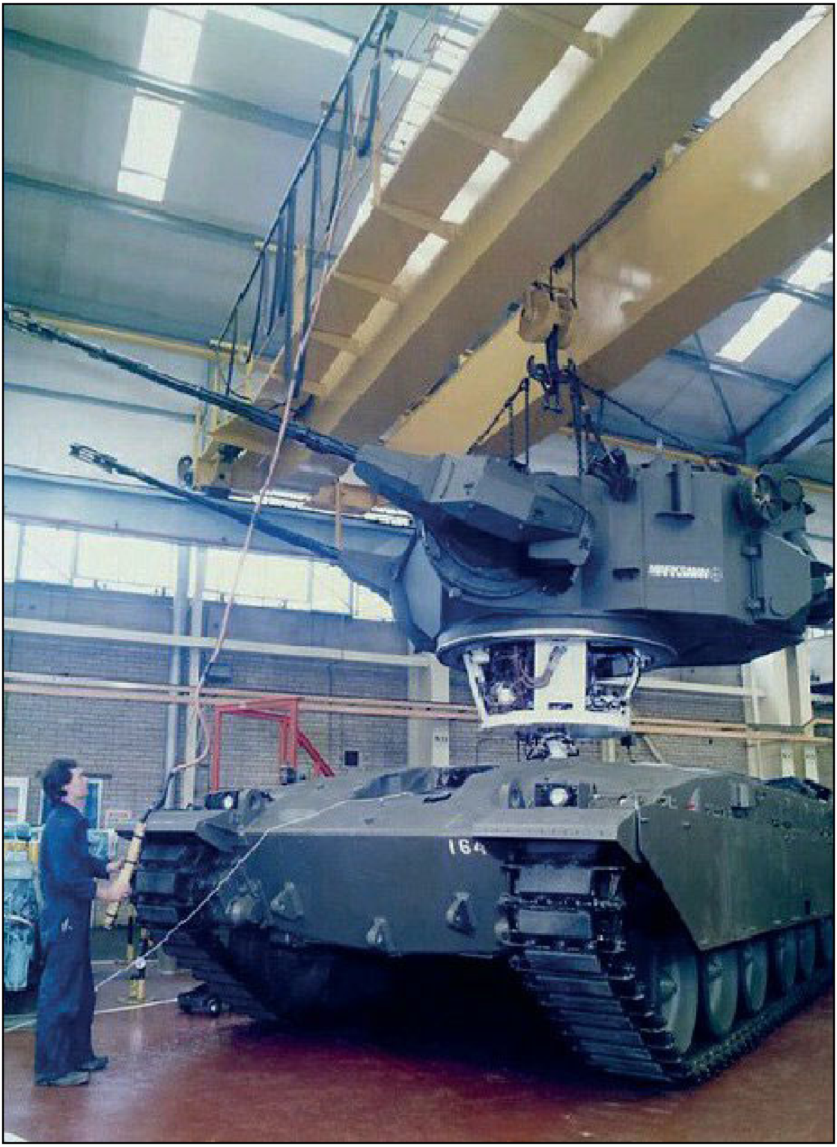


Front view showing the layout of the commander's cupola, with the sight door closed. The washer and optics around the cupola can be seen, and to the left of the cupola is the GPMG mount. (Rob Griffin)

This gives a very good outline of the rear bin lid. (Neil Palmer)



A close-up giving good views of the TISH (Thermal Image Sight Head), the gunner's sight hood and the multi-barrelled smoke dischargers. The fact that a green flag can be seen flying shows the vehicle is on the ranges and all weapons are clear. The mast behind the cupola is only fitted during firing periods and it relays live information back to the control tower/van on what is happening inside the turret when in action.

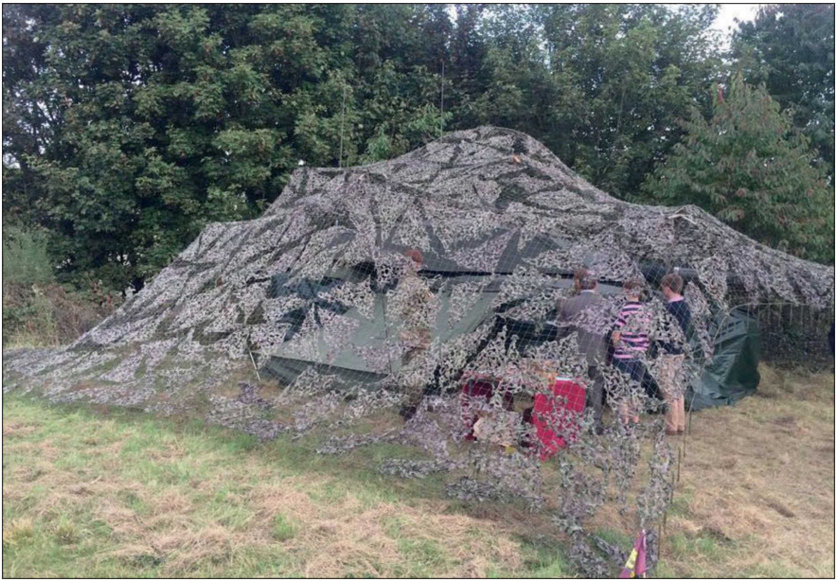


A good head-on shot showing the layout of the turret front before the fitting of the TOGS equipment. (Challenger Tank Appreciation Society)

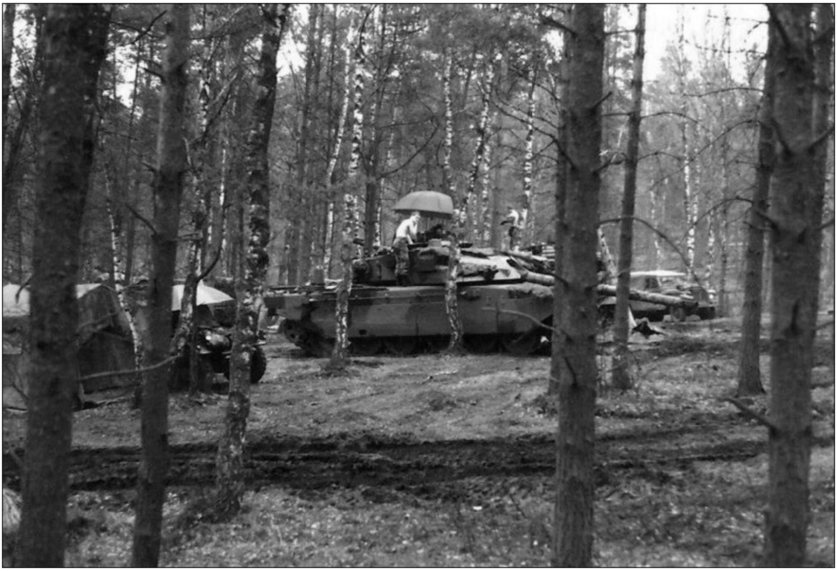
The crew layout is conventional, with the driver located in the front of the hull, and in Challenger's case in a central position, which gives him a much better view and appreciation of the tank's width when driving in the opened-up position.

The remaining three are the turret crew, with the gunner positioned on the right inside the turret looking from the turret rear, the vehicle commander is located on the same side above him and the loader/ operator is on the left-hand side. Access is via split hatches on the loader's side and the single hatch on the commander's cupola, this means that once the gunner is inside he is stuck, and should something happen to the tank he would have a battle to exit the turret, although many tales abound of gunners trying to escape past the commander before he has chance to leave the turret. Let's look at each individual crew station.

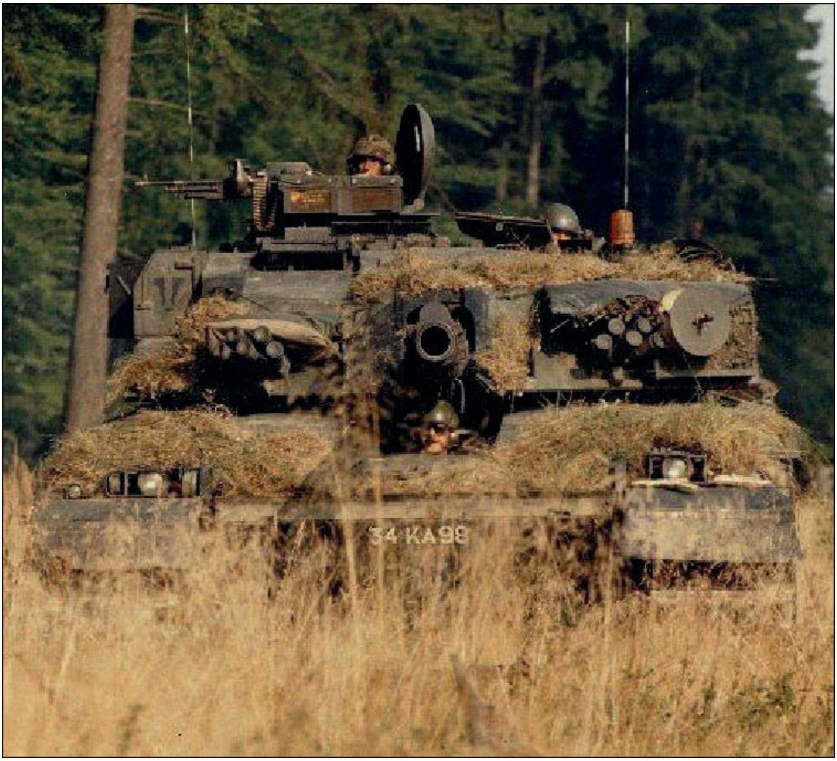
Starting with the driver, who very often seems to be the one member who is always overlooked when crews are discussed. He is located centrally in the front of the vehicle and has by far the best seat of all the crew. This seat can be used in the raised position to allow him to drive 'head out' or lowered and reclined for closed-down driving, the headrest is adjustable to allow him to see from his periscope and it also allows him to get very comfortable at night in his sleeping bag. The driver's hatch is of the lift and swing type and is secured in the open position by a locking catch. With the driver in his seat all the controls are within easy reach and can be found simply by touch rather than looking down. On either side of the driver are the steering levers. These can be locked up for driving opened up or lowered for closed down and are connected by an interlock which allows one-handed steering: pull the left lever back and the right lever goes forward: there is no truth in the tale that this was invented to allow the driver to be able to drive while drinking tea.



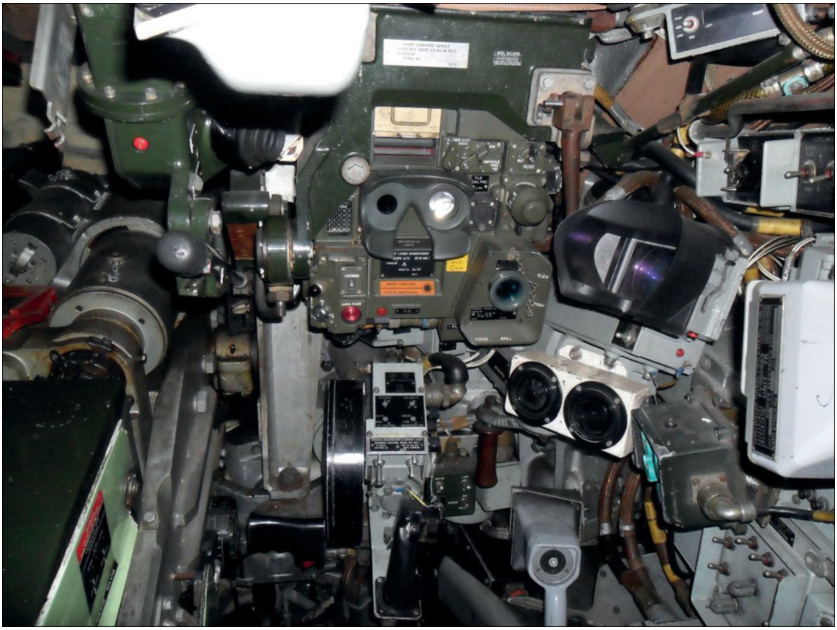
Although the two little boys and adult rather give the game away, this image does contain most of the elements of camouflaging your tank. The net is supported and pulled well away from the tank thus breaking up the shape, a sheet is hanging over the glacis, which hides the obvious gap that would be created, and the tank bivvi has been erected alongside it. (Kev Taylor)



A typical scene in a tank hide. Judging by the other vehicles in the scene, and the 9x9 tent to the left, This may be a squadron headquarters location. Note the use of an umbrella, a very typical armour idiosyncrasy. (Challenger Tank Appreciation Society)



Although now frowned on this shows the effectiveness in using live camouflage to help break up the vehicle outline, although care has to be taken as it soon dies off and loses colour, which will make it stand out when hidden in woods. (M Hopkins)



A very good view of the gunner's station in the Challenger. Shown from left to right: the gun cradle with one of the recoil buffers to the left of it, centre is the tank laser sight, directly below are the controls for hand elevation as well as the box to control the Muzzle Reference System located on the end of the barrel, on the right is the gunner's viewer for the TOGS system and directly below that are the blowers to give him fresh filtered air in the event of a Nuclear, Biological and Chemical (NBC) situation. (Rob Griffin)

Front left and right are the main instrument panels, with the gauges for various systems. They also include the starting panels for both the main engine and the auxiliary engine. The revolution and fuel control levers for the auxiliary engine are located on the floor by the driver's right side. The one big difference for the driver compared to Chieftain is that there is now no longer a gear control pedal, which was driver-controlled. In its place is a small stubby gear shift located on the right side of the driver's seat. It is a shift lever and is protected from the ingress of dirt and moisture by a black rubber gaiter. The ranges available for the driver to select are four forward gears: F1, 2, 3 and 4 then R (Reverse) 1 and 2; all changes are carried out automatically. The driver also shares his cab with the two sets of 12 volt batteries located either side of the hull and a three-round rack for the storage of three projectiles. During daylight closed-down operation the driver is provide with a No. 36 periscope. This can be replaced with an Image Intensifier Sight for night driving. A wiper and washer system is provided for the sights.

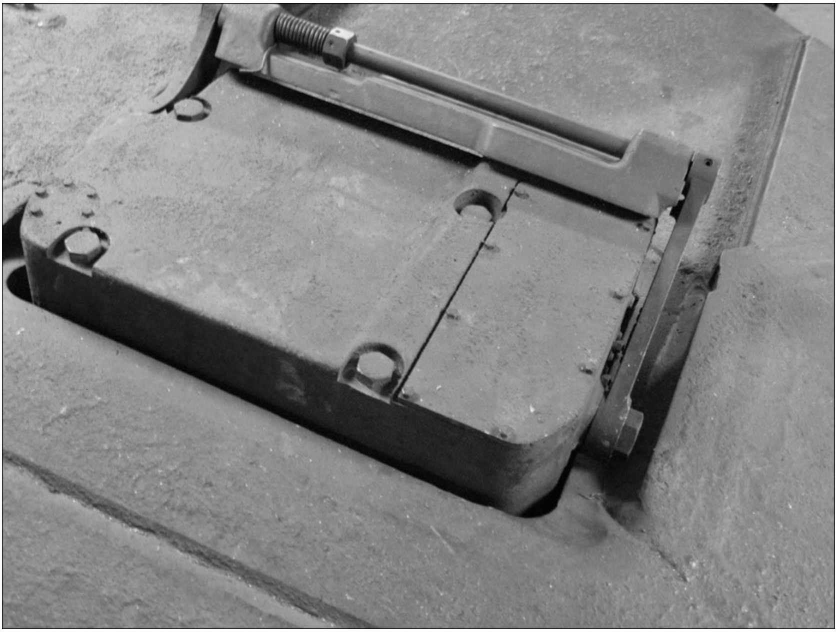
Next we look at the gunner, who has probably the most cramped and uncomfortable crew position: one thing is certain, it would win no awards for ergonomics. Located on the right side of the turret and below the commander, he has a small padded seat with a removable backrest, although a lot of the time he will find he is actually up against the commander's knees. Although it is a cramped position, all the controls the gunner needs for laying the gun, finding ranges, and actually firing it are to hand. The biggest problem is that the gunner is to all intents and purposes sitting in a Chieftain gunner's position, and although some equipment has been updated most of the 'add a bit more on' issues that were part of Chieftain as it updated are prevalent, and as Challenger received the TOGS system even more was bolted on and added.

Typical tank hide, the crew have tried to get the net as high as possible to break the outline but it also allows them easier access to the tank. Camouflage nets have a life of their own and will attach to anything, also the sheet over the glacis breaks up the gap which would look unnatural. (Mark Appleton)

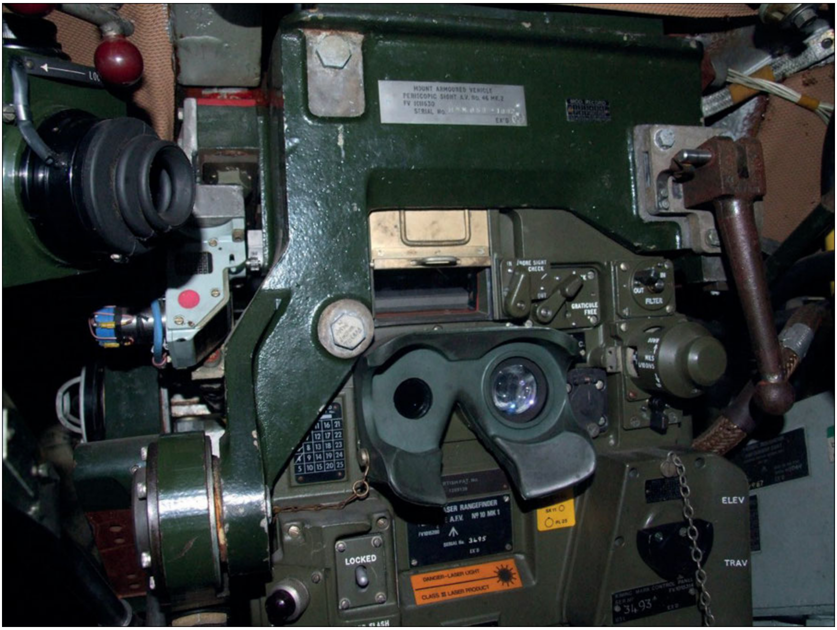
The track adjuster stowage located on the glacis plate, unlike the Chieftain which had stowage bins all around, the Challenger is short of stowage space. (Rob Griffin)

The gunner has located on the right side a two-speed hand traverse control that allows him to traverse the turret a full 360° but a most tiring exercise it is and is avoided if at all possible. Just off centre between his legs he has the hand elevation control which also contains a firing switch for the main armament and the coaxial machine gun. On the floor are two pedals, the left one is for firing the machine gun and the right is for firing the laser rangefinder.

Directly to his front is the tank laser sight, this can be one of several versions but they all provide the same information. The sight will display a lased range in the right eyepiece while the other is used for observing, the sight has two power settings for viewing: X1 for general scanning and X10 for firing.



The armoured shield over the gunner's sight, this can be wound up or down from inside the turret, giving the sight some protection from debris that may be flying around during combat. (Rob Griffin)



Close-up of the gunner's laser sight, there were several versions but they all look similar to this one. The right eyepiece is for viewing the target while the left one displays the lased range. The large vertical lever on the right is the locking lever to retain the sight in its mounting. The eyepiece visible on the left of the image is for the emergency sighting system telescope. (Rob Griffin)

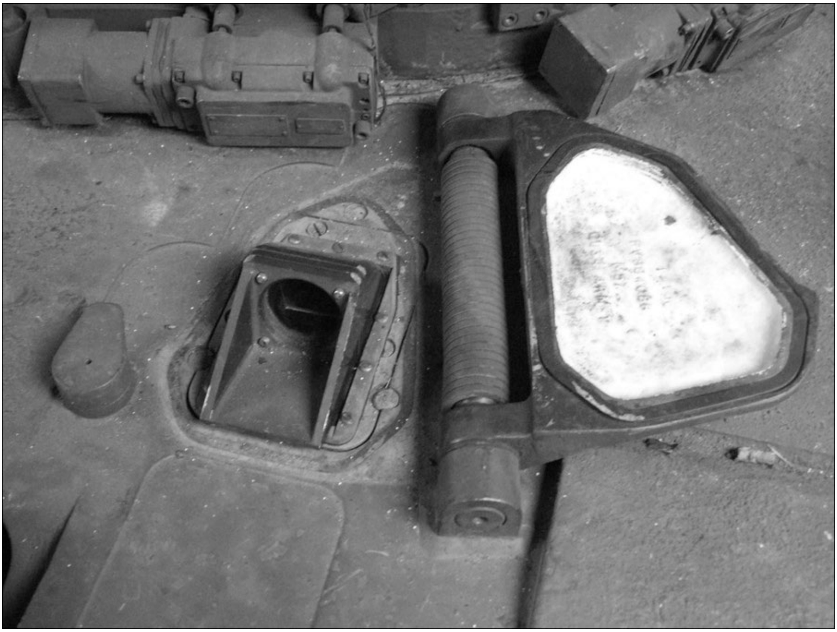
Other controls that provide various services for the gunnery equipment are located around his station, within easy reach. The computer for the Improved Fire Control System (IFCS), which greatly improves the chance of first round hits, is located beneath his feet.

The third member of the crew is the operator/loader. As the title suggests his is a double-hatted job. He is located on the left side of the gun and is the only member of the crew who can actually move around in their station, albeit not very far. Looking to the front of the turret on the left of the gun cradle is the coaxial mounting for the 7.62mm GPMG: the loader's job is to load this weapon when required and to maintain it while it is firing, not easy when the tank is moving across country and the gun stabiliser is moving up and down. Great care is required not to get trapped between the turret roof and the gun.

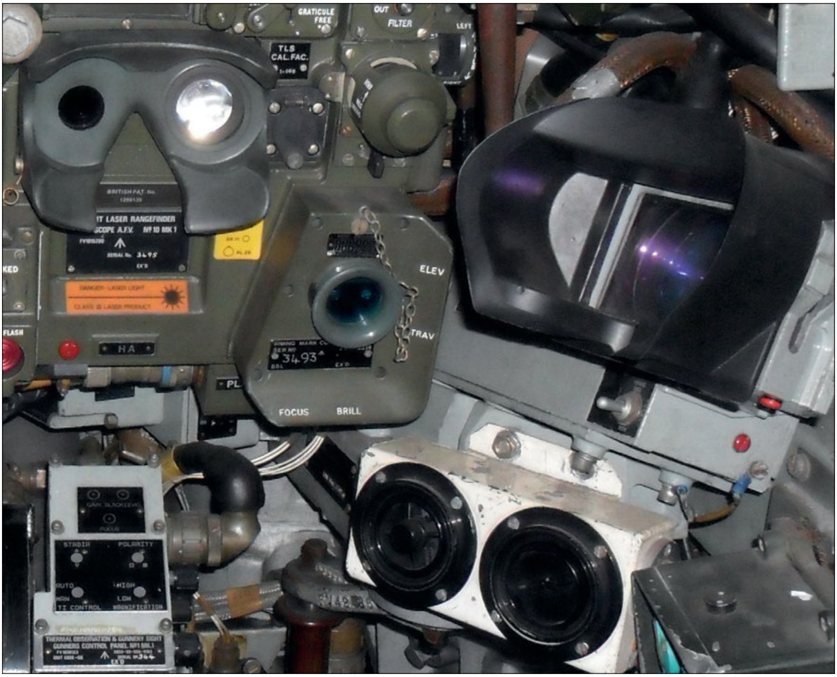
The loader is also responsible for the loading of the 120mm gun and ensuring that any misfires are cleared as fast as safety will allow. The ammunition is located in racks around his side of the turret and also some on the turret floor; some are easy to reach while the remainder are used to replenish the ready rounds when a lull in firing occurs.

As the operator, he is responsible for ensuring that all the radios are tuned to the correct frequency and is also responsible for maintaining a listening watch and helping the commander encode and decode messages; often the operator will have his own map and be able to assist with map reading. However, the rest of the crew would consider his main role as tea and food provider, because he has the most room and, importantly, the 24-volt boiling vessel is at his station. This item may look rather dull but it is the one item on board that is prized above all others. It enables a constant source of hot water to be kept, into which the boil-in-the-bag rations can be quickly cooked and also provides a constant stream of tea and coffee. Crew often joke that if the boiling vessel is broken then the tank is useless.

The commander is the last crew member to look at. Although you could say his is the most important job on the tank, it is the whole crew that makes it work. The commander is responsible for fighting the tank, by being in the correct location and adopting the correct tactics; he gives fire orders to the gunner and on certain shoots retains control himself. He has controls similar to the gunner for controlling the gun laying but he also has the facility to override the gunner. The commander's cupola gives him all-round vision from the nine periscopes located around it and a No. 37 periscope sight is linked to the gun by linkages. This will give the commander either X10 vision or X1 for general viewing. His seat can be pumped up to give him a head-out position for opened-up viewing. He also has a control box that allows him to input corrections for range when using the IFCS system. It is also used for servicing the equipment and will show up any faults. He is equipped with a GPMG and spotlight linked to the sight linkage. Optimistically this could be used to engage air threats but the probability of a hit is low; it is more useful is for engaging infantry targets or for speculative fire on likely enemy positions. The commander will be either the troop commander of three tanks, the sergeant or the corporal, apart from officers. Commanders usually work their way to the coveted seat by doing one or more of the crew jobs.



The cover over the sight head of the emergency sight. The cover is operated from inside to open but closing has to be done from the outside. (Rob Griffin)


GRATICULE FREE
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LASER RANGEFINDER
SCOPE A.F.V. No 10 MK 1
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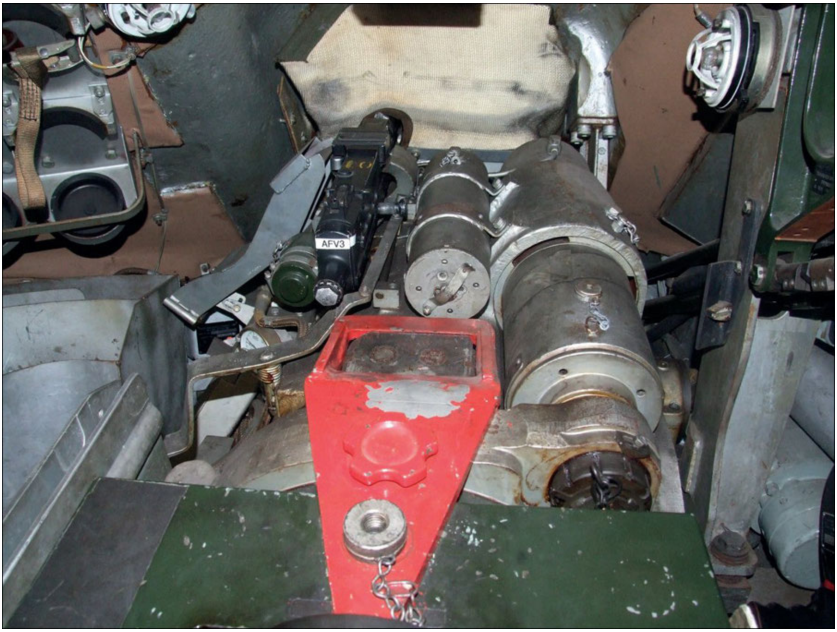
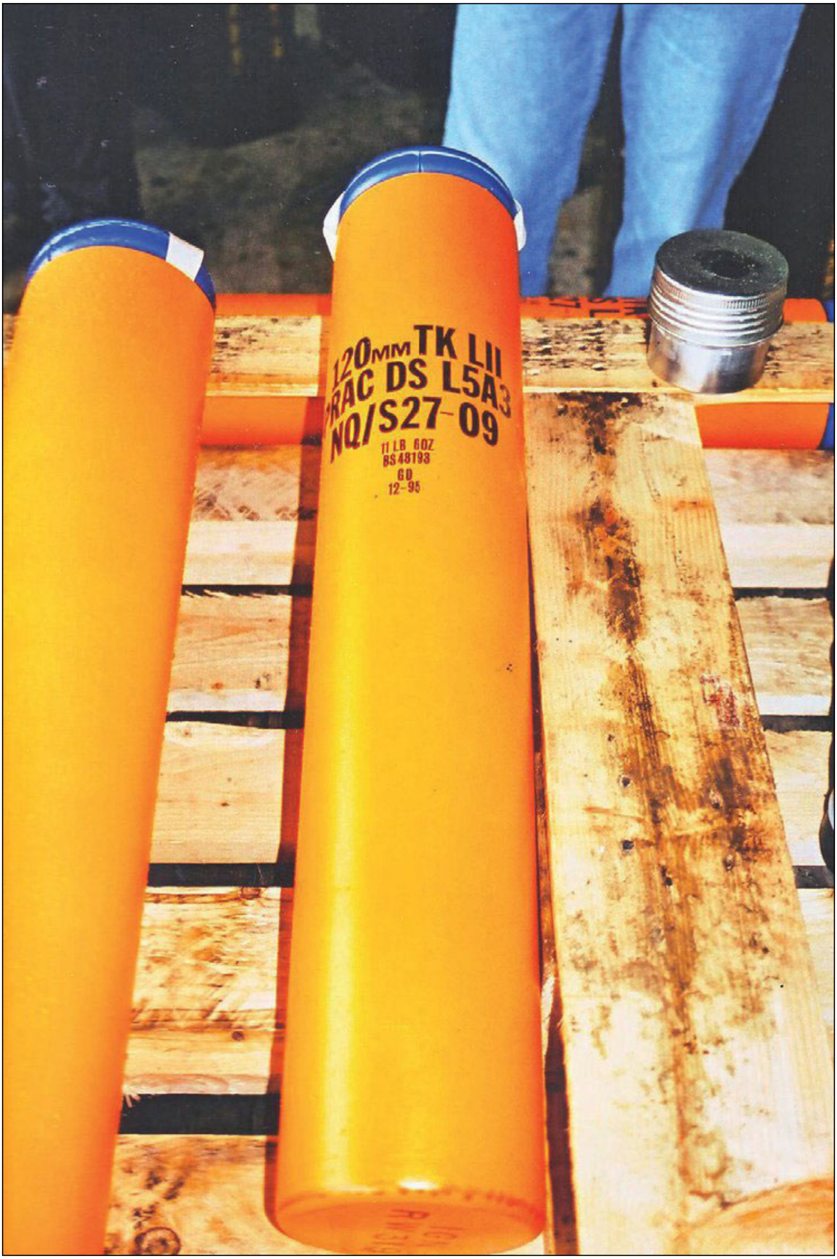
CLASS 3B LASER PRODUCT
FLASH
HA
ELEV
TRAV
3493
FOCUS
BRILL
STADIA
POLARITY
AUTO
HIGH
LOW
TI CONTROL
MAGNIFICATION
THERMAL OBSERVATION & GUNNERY SIGHT
GUNNERS CONTROL PANEL No1 MK1

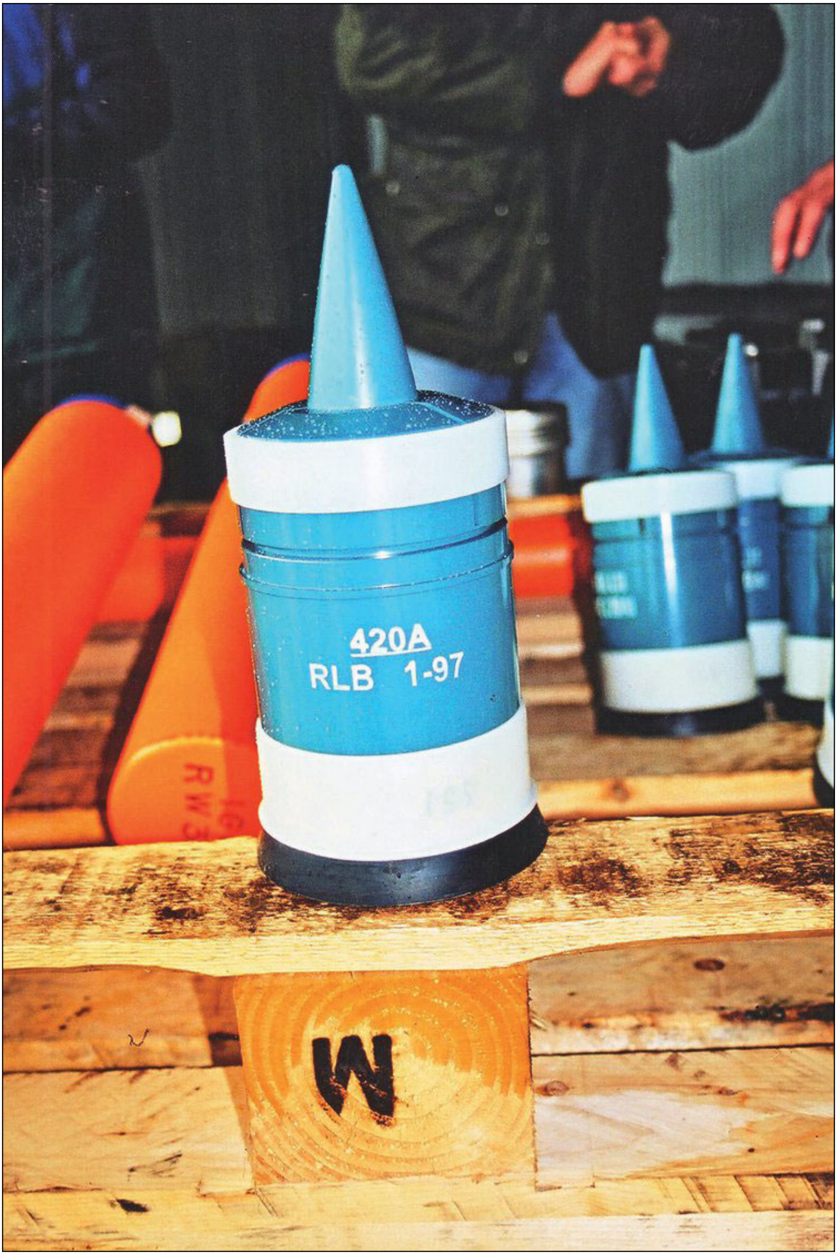
A close-up of the gunner's station in the Challenger. To the left is the tank laser sight nd below that are the controls for hand elevation as well as the box to control the Muzzle Reference System, located on the end of the barrel. On the right is the gunner's viewer for the TOGS system and directly below that are the blowers to give him fresh filtered air in the event of an NBC situation. (Rob Griffin)



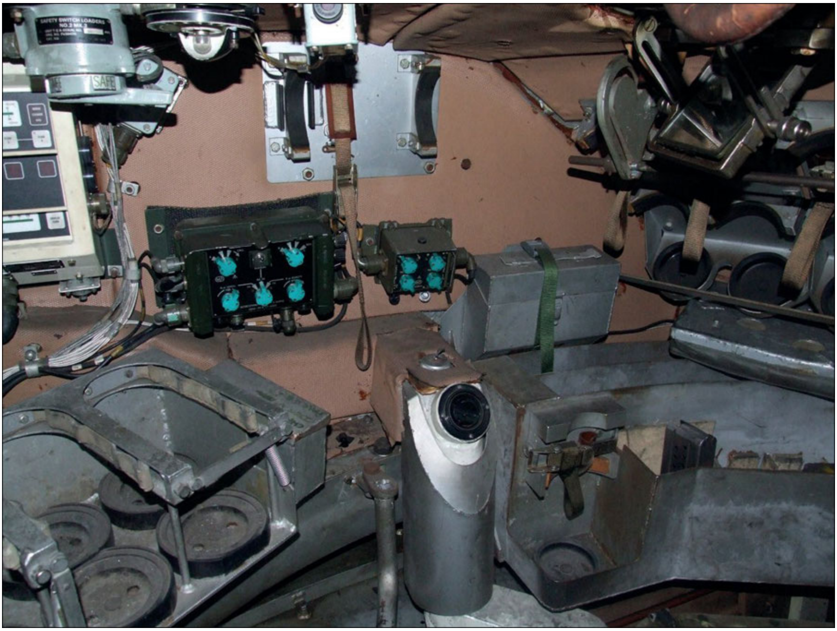
The gun cradle looking from behind the gun. On the left is the 7.62mm General Purpose Coaxial Machine Gun with its feed tray to its left. The two tubular objects are part of the recoil system, the larger one is a recoil buffer and a similar one is located below the cradle. The smaller one replenishes the system. (Rob Griffin)


120MM TK LII
RAC DS L5A3
NQ/S27-09
11 LB 6OZ
BS 48193
GD
12-95

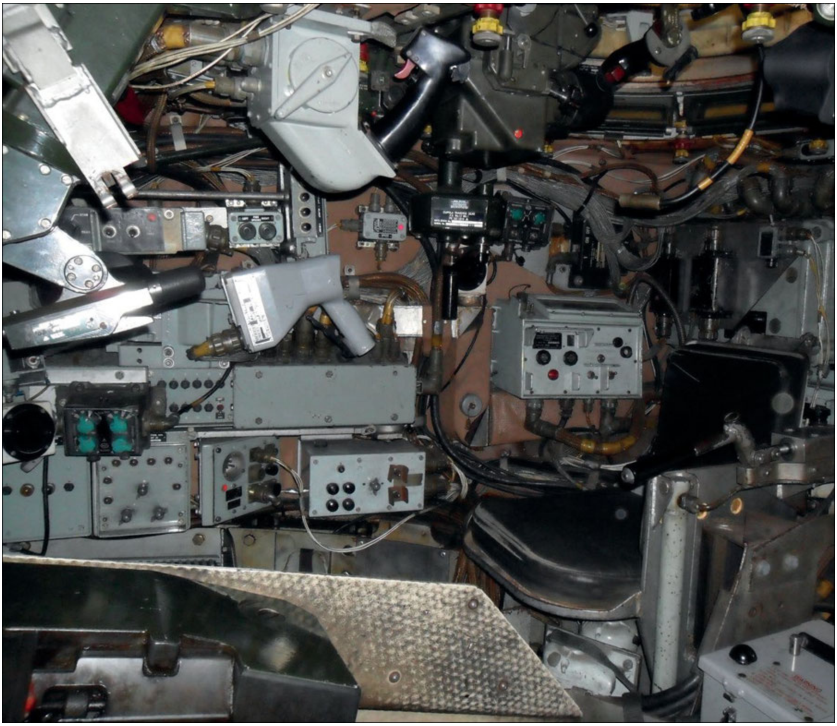
The propelling bag charge for the DS/T round. The whole of the case is consumed when firing, leaving only the brass vent tube of .625mm in the turret rather than a 120mm brass case. The vent tubes are contained in *a screw top tin containing 10 rounds which can be seen top left of the picture. (Rob Griffin)*


420A
RLB 1-97

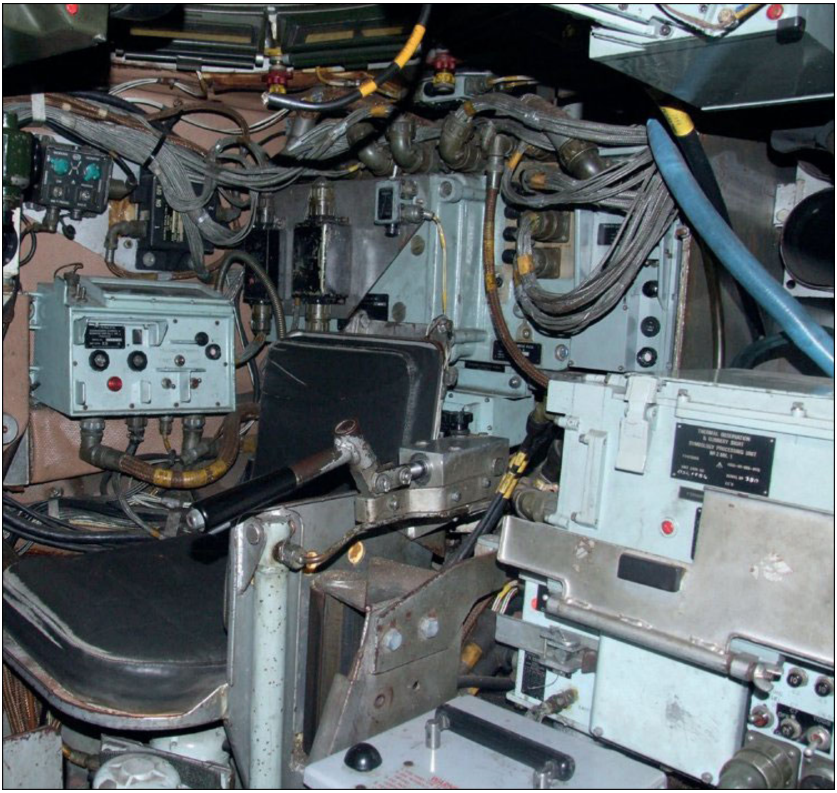
The practice round for Armour Piercing Discarding Sabot as used by the 120mm L11 gun on Challenger. This has similar ballistic qualities to the service round but does not contain the tungsten core. (Rob Griffin)



Looking to the loader's station from the gunner's seat, visible in the front of the picture are some of the projectile stowage racks. The green boxes on the turret wall are for the old Clansman radio system. (Rob Griffin)



Looking from the loader's station across to the commander's area, at the bottom right of the picture is the most important piece of equipment on the tank, the crew boiling vessel. The handle in the centre of the picture is the commander's power controller with which he can lay and fire the gun. When using this he overrides the gunner's similar controller. To the right is the commander's seat which can be hydraulically pumped up so the commander can remain sitting in a head-out position. (Rob Griffin)



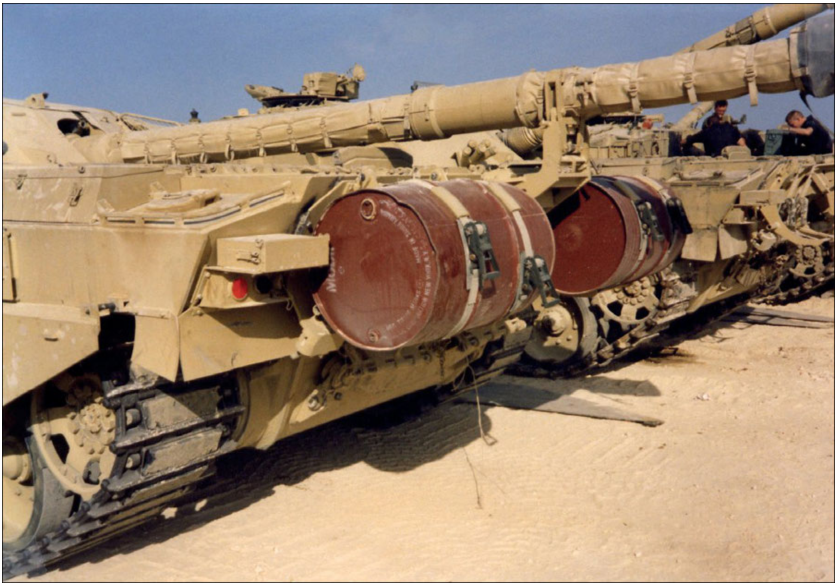
Another view of the loader's station. The box to the right of the seat is used by him to input fire correction into the computer. It will also display fault codes with the system. The panels behind the seat house the power equipment for the gun traverse and elevation system. (Rob Griffin)

Challenger 1 Main Battle Tank Variants

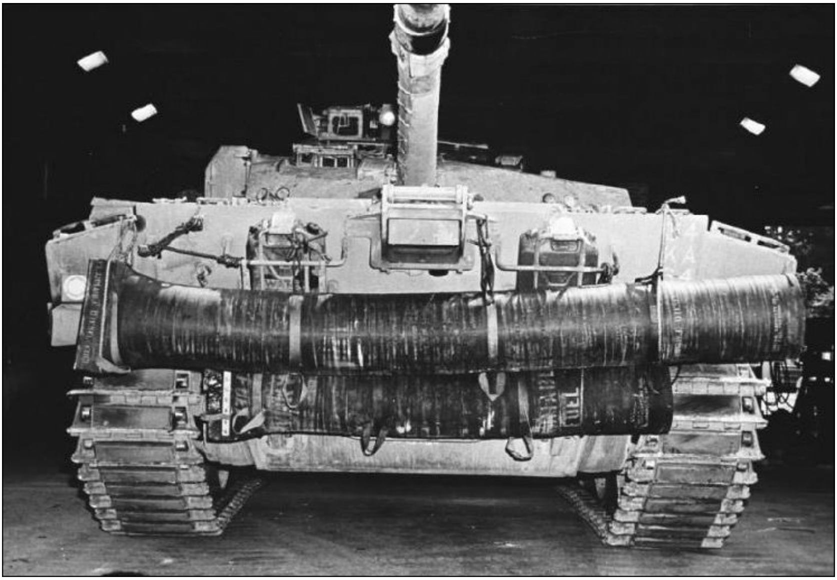
Due to the fact that Challenger had a relatively short life in the British Army of approximately 18 years it never produced as many variants of the main battle tank design as its predecessors the Chieftain and Centurion, who both reached double figures in mark variants as gun tanks. In United Kingdom service, the variants have really been in various upgrades, but leaving the basic tank shape unchanged. One feature of Challenger that seems always to have been there are the rear-mounted fuel drums, but this is not the case. Originally, when the Challenger entered service, the rear hull had just the tools located there and no fuel drums. However, it was realized that it was quite a thirsty beast and really needed to be topped up with fuel at least once in a working day, and more if driven hard on operations or exercises. Various ideas were suggested and in keeping with British eccentricity some were better buried in the archives. One that did have interest shown in it was the idea of resurrecting an idea from the days of Centurion and having the tank tow a trailer, but then sensible heads prevailed and the problems that the Centurion suffered, including reversing over its own trailer and lack of mobility, meant that it was consigned to the dustbin. Another drew on the Panzers of the Second World War and suggested a rack holding the ubiquitous jerry cans could be fixed on the back decks. Again, for reasons which were blindingly obvious to any crew man on the tank park, but not to designers, it too was discarded.

The answer really had been staring them in the face. For years the Soviets had carried fuel drums on the sides or rear of their tanks. When a top-up was required, it was taken from these drums, and if there was contact they could easily be discarded. Therefore trials were carried out and three Challengers were modified to carry the drums. The trial proved the feasibility of such a system and the modification was fitted to the fleet and was carried over onto the Challenger 2.

As originally issued the first Challengers did not have the barbette for the TOGS night/gunnery system fitted and the area that it would be located in was simply plated over, giving the turret a very flat, uncluttered look, although later most of these were converted into TOGS, although some remained as training vehicles. These were classed as Challenger Mk 1: First production version.

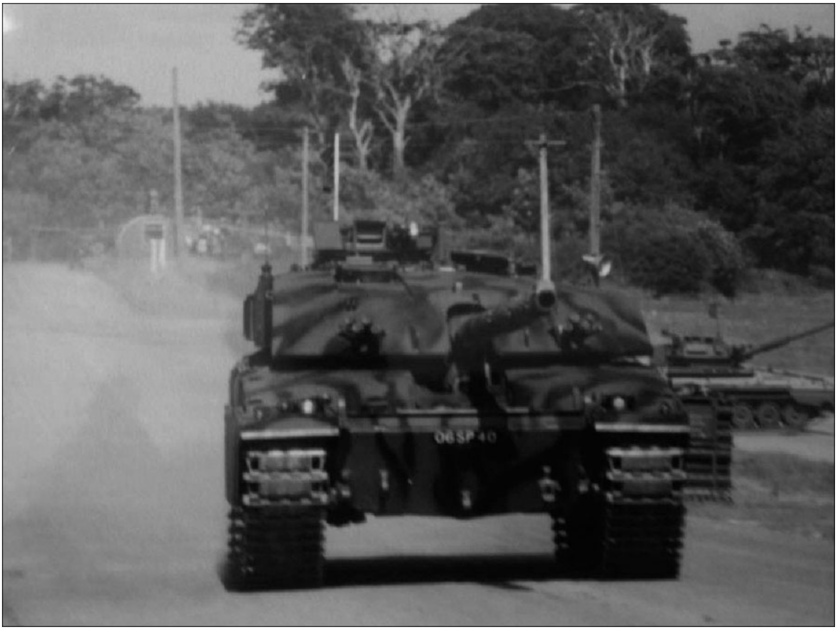


This image shows the fitment of the fuel drums and the thermal sleeve. The drum colour makes a strong contrast with the desert camouflage. (Dennis Lunn)

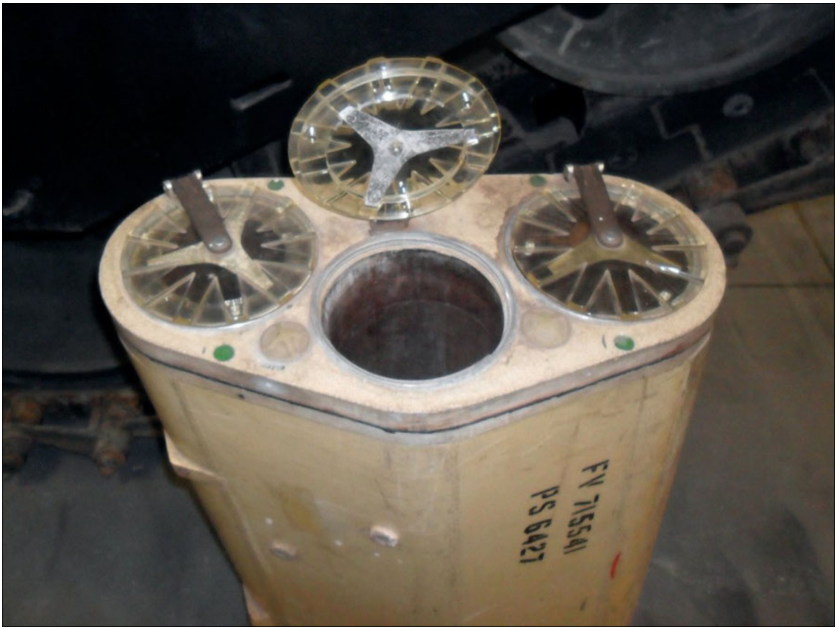


A rare image showing what came before the incredibly simple idea of fuel drums, a flexible fuel bladder. If issued, it would have been an environmental disaster waiting to happen.(Ed Webster)

Next came the Challenger Mk 2, these were production vehicles and came with TOGS already fitted. These really changed the training in the BAOR (British Army of the Rhine) as now the 24-hour battlefield became a reality. Challenger Mk 3: the major difference for this mark and partly the reason it was chosen to go to the Gulf on Operation Granby was the discarding of the water-filled bag charge containers that had served since the days of Chieftain.



06 SP 40 one of the prototypes, seen here at Lulworth Ranges during a firepower demonstration, the interesting thing here is the unusual camouflage of tiger stripes, which the Armoured Trials and Development Unit (ATDU) thought looked good. (Rob Griffin)



The original charge bin fitted to Challenger and Chieftain, each section holds one armourpiercing fin-stabilized discarding sabot (APFSDS) charge or two High Explosive Squash Head (HESH) shells, the plastic lids rotate then lift up. Inside the double walls of the container is basic issue anti-freeze under low pressure which, if the container is penetrated, will flood the charges to prevent them from exploding. (Rob Griffin)

These held each charge in a separate tube which itself was part of the large charge bin. This was filled with current military-specification coolant under around 7psi pressure. The theory was that if the container was penetrated by hot metal from enemy fire, the coolant under pressure would saturate the charges and prevent them igniting. For a long time this was blindly taught and many instructors had this as a lesson to teach, in the firm belief it was true. Later trials proved that the system was not as good as thought and probably would not work. From then on the charge bins were armoured and were designed differently.

That was the amount of variation in the MBT role for the

Challenger, in its United Kingdom role. It did however serve as the basis for specialized vehicles which we look at later.

Challenger had no other overseas buyers, and when it was decided to replace it to allow the introduction of Challenger 2 it was decided that virtually the whole Challenger fleet would be sold to Jordan for £1 per tank as, according to the Ministry of Defence, they were only worth their scrap value. However, the value of their spares, support and training crews, to enable the Jordanian Army to introduce Challenger which by now had been renamed in Jordanian service as Al Hussein, would run into the millions.

Prior to the tanks leaving the United Kingdom, they were given a 100 percent overhaul by Army Base Repair Organization at Bovington Camp. Once the tanks arrived in Jordan the King Abdullah Design and Development Bureau took them in hand and carried out various modifications to bring the tanks in line with the Jordanian Armoured Corps requirements. These included a new fire-control system; replacing the loader's periscope with a far more enhanced version; a commander's panoramic sight; the original auxiliary generator was replaced by a new unit; air conditioning was installed; the electrical system was replaced; and some tanks were retro-fitted with the RUAG, a Swiss technology company's 120mm smoothbore L/50 gun which comes complete with an autoloader. The venerable British L11 120mm gun was also still used so Al Hussein could be seen with either weapon fitted.

The final change was to the camouflage pattern which was changed to the Jordanian sand and chocolate digital pixel style, making it very distinctive. Challenger will be phased out and replaced by the Italian Centaruo wheeled vehicle mounting a 105mm gun. Currently 141 of these are in service and all are ex-Italian. However, Jordan did use some hulls to produce a most interesting turret that at one time was to be fitted to its Challengers. This did not proceed although it is said that several versions of this turret did exist

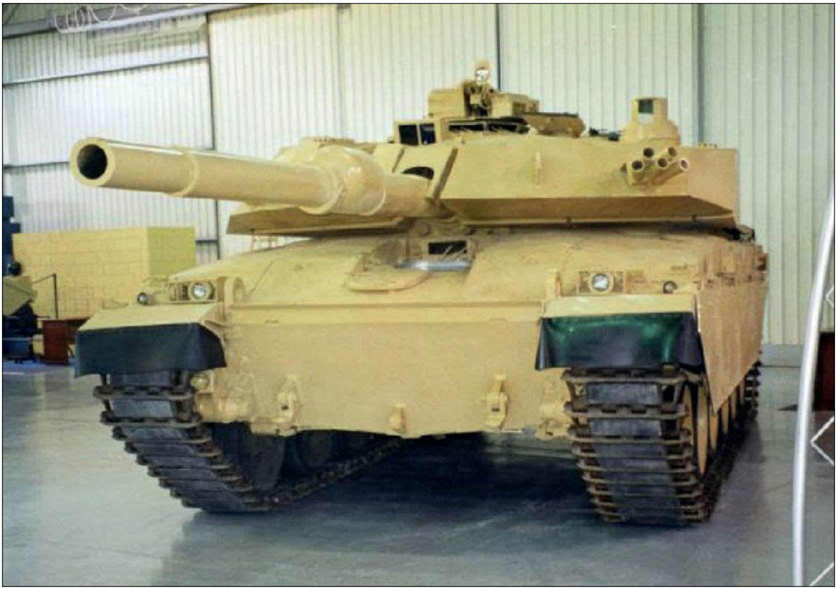
The Falcon turret was indigenously developed by King Abdullah II Design and Development Bureau and they also worked very closely with IST Dynamics of South Africa. It is said that components for the turret are also supplied from the United Kingdom and some

Swiss sources; unveiled in 2003 the Falcon turret was an attempt to increase the survivability of the crew by having them all located below the turret ring. This produced a turret base very similar to the United States Shillelagh missile-armed M60A2. However instead of using the American combined gun/launcher system, the turret incorporated the RUAG 120mm smoothbore that had been fitted to the tanks with the ‘conventional turret’. The turret shape lent itself admirably to the inclusion of an autoloader, thus saving more space by not having a human loader. It is stated that this weapon is capable of firing all NATO standard ammunition except that of the British L11 as it is rifled and the only rifled weapon in NATO, the RUAG 120mm, is also used in another conversion of the Jordanian Army where it is fitted to their M60 tanks. This provides a great deal of standardization for ammunition, which is a great aid to the logistics of resupplying the tanks in the field.

The autoloader is claimed to be able to provide a rate of fire of eight rounds per minute, but as only 17 rounds are carried in the autoloader, it would not be long before resupply would be necessary. This highlights the point that in a turret with a human loader, far more ammunition can be accessed quicker than an autoloader. The tank may have to pull back while the turret is traversed to allow access, but it is a quick procedure. For the Falcon-equipped vehicle even more protection is given to the crew by the inclusion in the turret of blow-out panels. These are panels in areas that are deliberately created as weak points so that in the event of the turret being penetrated, and pressure building up, the panels fail and are blown off, allowing the blast to be vented out of the turret. The American Abrams makes great use of these.

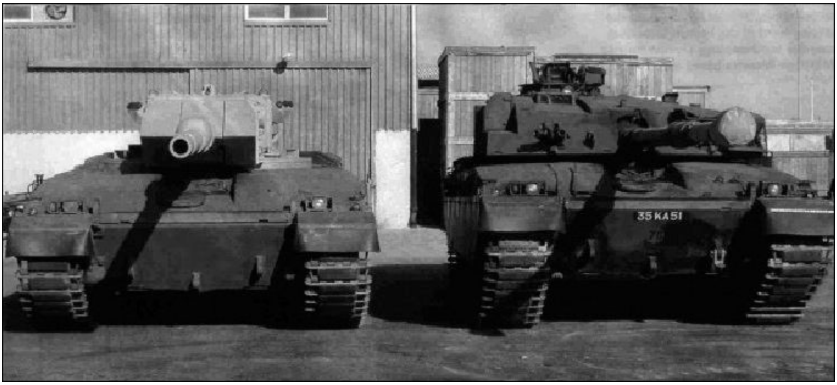
The turret is equipped with a 7.62mm coaxial machine gun as secondary armament, and multi-barrelled smoke grenade dischargers are fitted either side of the turret. The commander and gunner each have their own access hatch and sights, with the commander’s sight being fitted to the turret roof. The shape of the turret incorporates modular armour which it is claimed can be replaced in the event of battle damage, and the turret front is also protected by extra layers of armour. Unsurprisingly the original turret was known as Falcon 1 and it was said that various other versions were being designed that would include an upgraded autoloader containing more rounds. However, with no serious buyer and the phasing-out of the Al Hussein, the project seems to be at a standstill.

Challengers on parade with the Royal Jordanian Army. (Brian Gill)



Challenger with the RUAG 120mm smoothbore fitted. (Courtesy Defence News)

The Jordanian conversion of Challenger 1 fitted with the Falcon turret mounting a 120mm smoothbore gun. Note how low down the crew are in the hull compared to a normal MBT turret. (Mil Today)



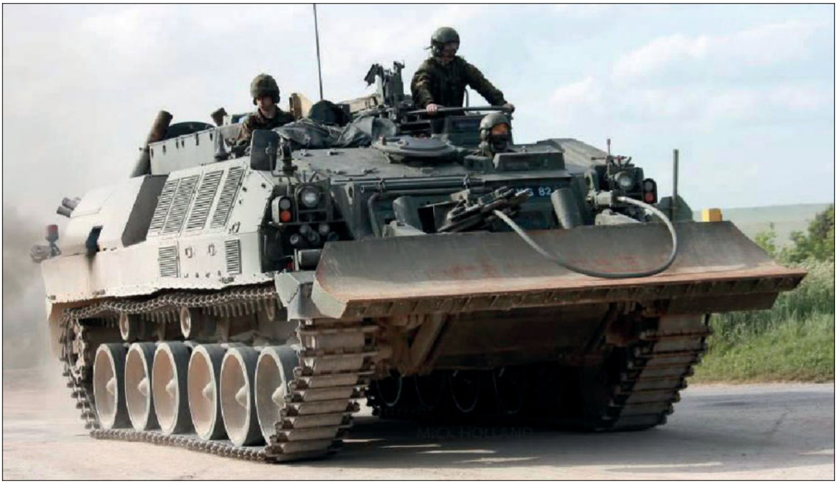
Little and large: this rare image shows a standard Challenger tank alongside one fitted with the Falcon turret as used by the Royal Jordanian Army. (Challenger Tank Appreciation Society)

Challenger 1 Specialist Variants

Despite its short (for an MBT) service life Challenger 1 managed to be the basis for two in-service variants, both of which survive today in the Challenger 2, albeit in slightly different forms. It is common practise to use the hull from the current main battle tank chassis as the basis for specialized armour. This is usually for support vehicles with the most common examples being the Armoured Recovery Vehicle used by the REME who are attached to virtually every army unit using vehicles of any kind.

The others are the Armoured Vehicle Launched Bridge and the Armoured Vehicle Royal Engineers. The importance of these can be measured by the fact that all three were the last Chieftain variants to leave service. They provided the engineer support until Challenger 2 variants came into service.

Just to prove that tanks can't always go everywhere, expect a bit of digging before the REME can winch it out using the CRARRV. (Challenger Tank Appreciation Society)



A fine view of the Challenger CRARRV, taken on a hot dusty day on Salisbury Plain. Note the exhaust staining and the dust-covered wheels. (Mick Holland)

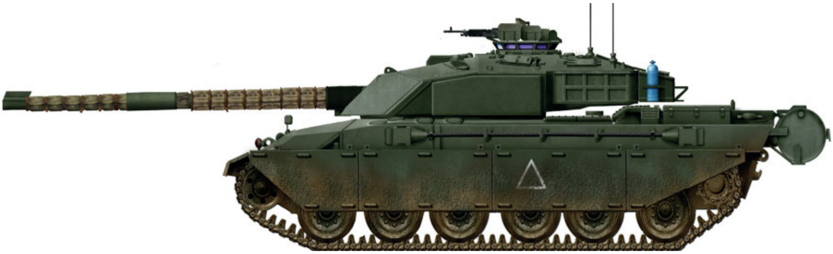
We will be looking at the two variants based on the Challenger 1 hull. The most important variant built on Challenger's hull is the Armoured Repair and Recovery Vehicle or CRARRV. The need for a vehicle such as this came about after the Challenger had been issued to the first operational regiment, the Royal Hussars. They quickly found that their elderly Chieftain Armoured Recovery Vehicles were not able to give the support needed to look after the Challenger fleet. At times it was hard pressed to recover a bogged or broken-down Challenger. This and its age meant the vehicle needed replacing.

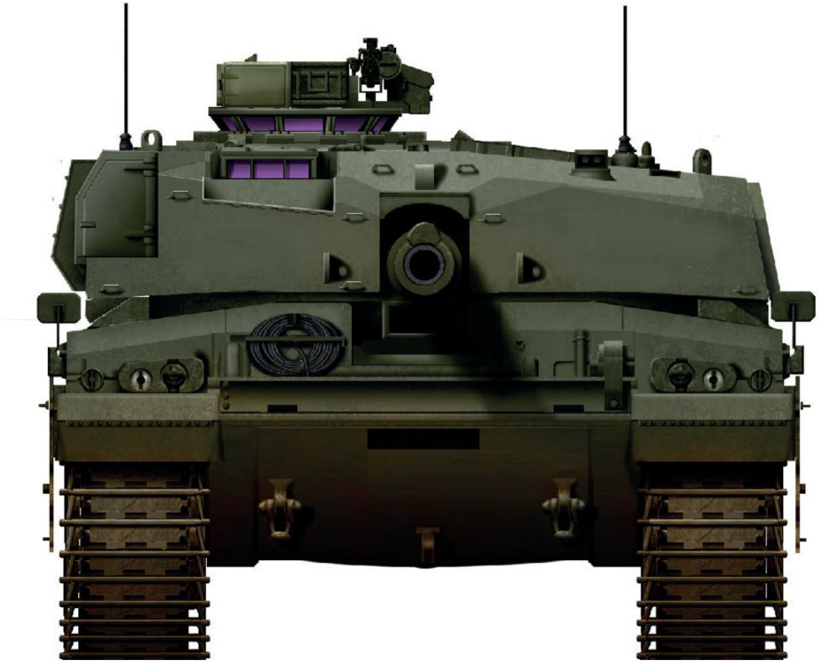
The Royal Ordnance factory (Leeds) was tasked to design and produce a vehicle that could be brought into service relatively quickly. A contract to enable this research and design was signed in

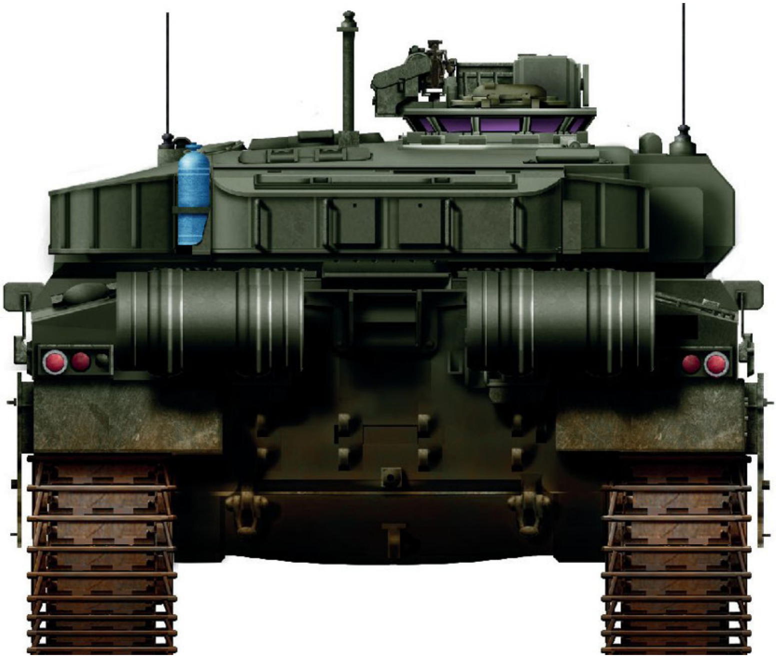
October 1983, and the resulting vehicle, known as the Challenger Armoured Repair and Recovery Vehicle (CRARRV) was produced. It is a front-line unit asset and its role is to recover, and move to a safe area, damaged or broken-down vehicles where they can be repaired by the CRARRV crew or left for other services to work on. It uses the basic Challenger hull but has a box-like welded plate superstructure in place of the turret.

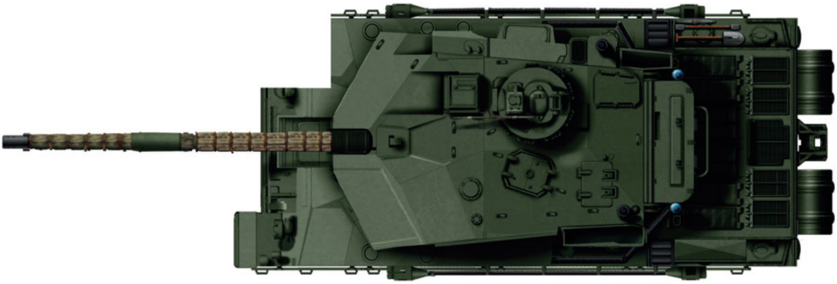
It is manned by a crew of three from the REME, but it also has space inside to shelter the crew of the broken-down vehicle, although this would be a temporary measure that might be used during an NBC-type attack, as the CRARRV has full NBC protection. Self-defence is limited to a 7.62mm GPMG and smoke grenade dischargers. Additional add-on armour can be fitted if required. The CRARRV is fitted with a powerful winch, with 50 tonnes straight going up to 98 tonnes pull using a pulley in a 2:1 configuration.

An interesting position for REME to carry out a recovery task. This Challenger seems to have really come to grief. (Challenger Tank Appreciation Society)



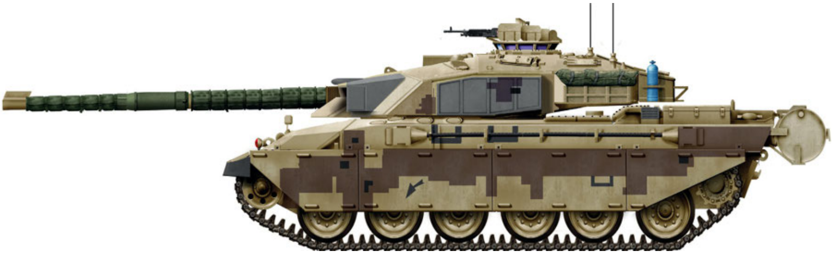


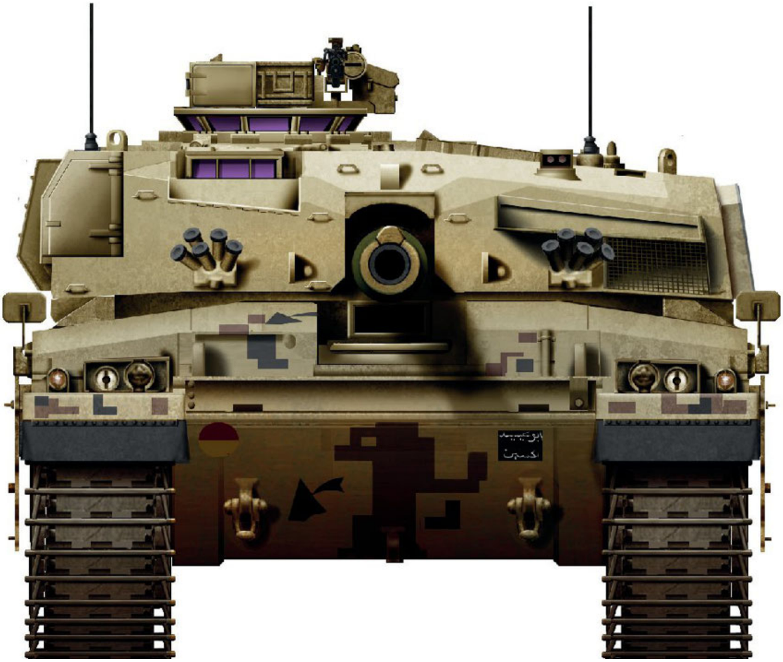


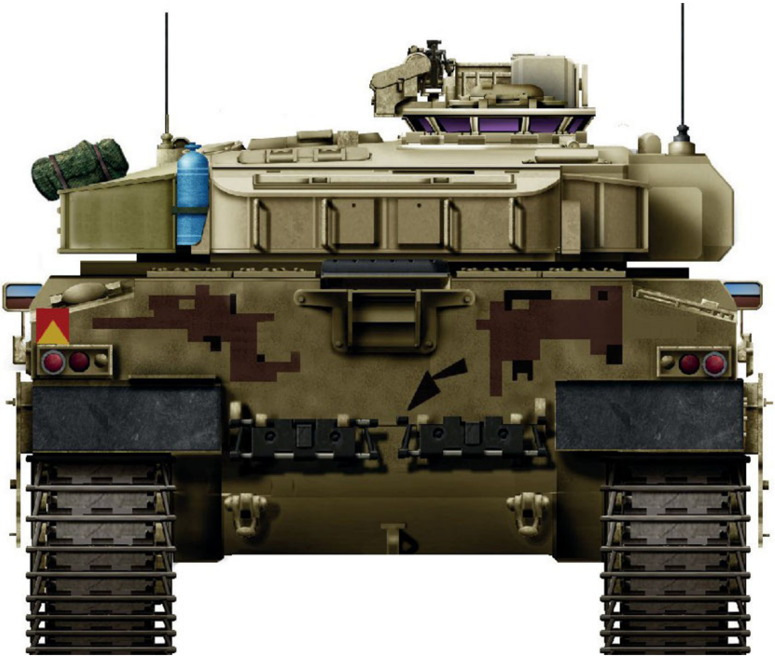


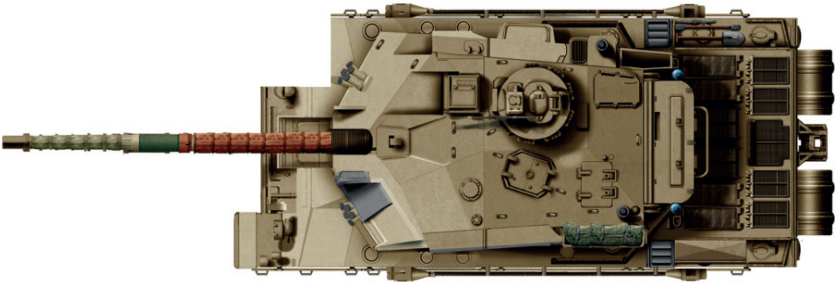
Challenger 1 Mk 1

This Mk 1 Challenger is finished in the now-standard colour of drab NATO green overall. For the time being the familiar black and green has disappeared, with the only variations being on troop in Tidworth, painted in the urban camouflage invented by Trooper ‘Henry Wilks’ 4/7 RDG and the scheme used in BATUS Canada. On the side view the squadron call sign indicator is painted on the bazooka plate: this is not a common practice but is sometimes seen. In the rear view the NBC container is still painted blue although this mostly will be a green colour. Interestingly the tank looks as if it has the meteorlogical probe fitted, the small mast on the turret. This was part of the original specification but was never issued. It takes weather readings as at the vehicle location and feeds that information into the fire-control computer, thus improving the chances of a first-round hit. Although the drawing shows wing mirrors fitted, these were not usually used as they got damaged too easily, the driver relying instead on instructions from the tank commander.



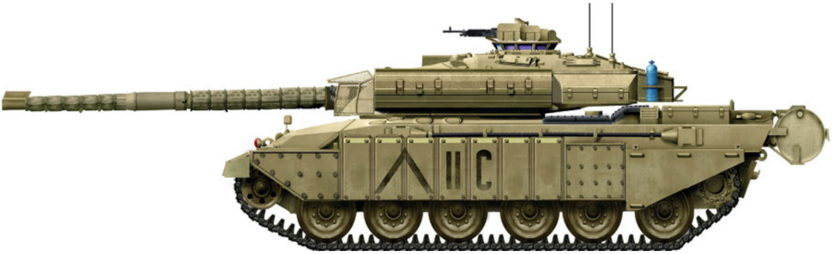


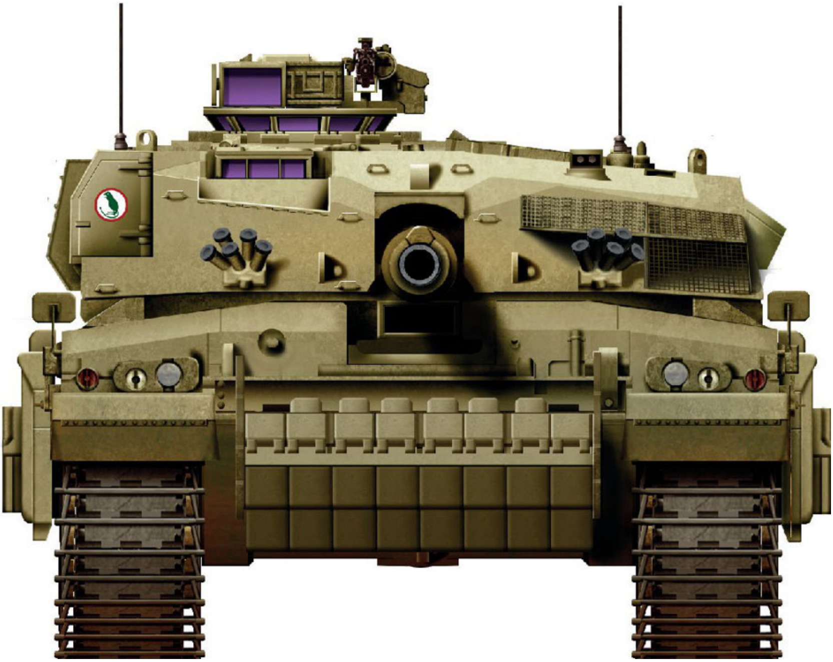


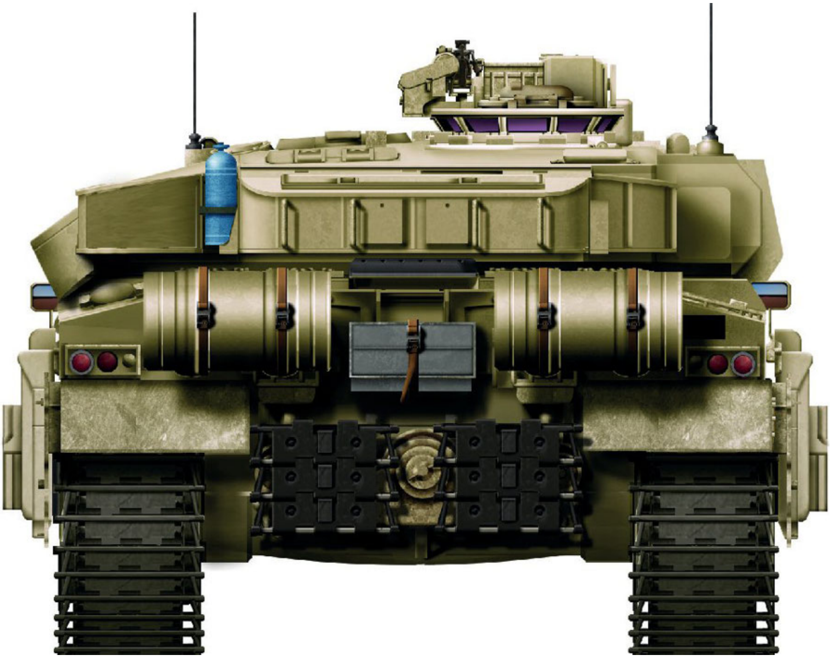


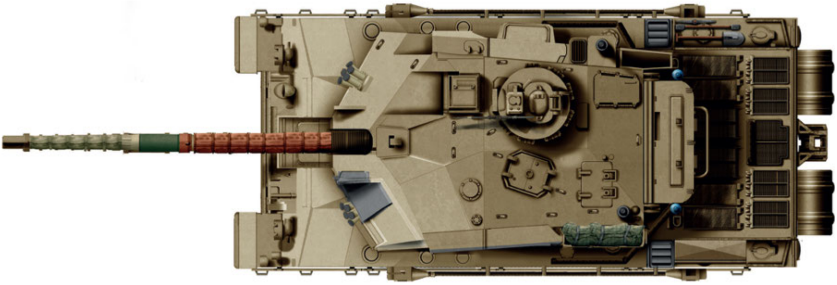
Al-Hussein

These four images show the basic Challenger as in service with the Royal Jordanian Army. The Jordanians have a mixed fleet of all marks that were used by the United Kingdom. The Jordanian Army are very low key on markings and these are usually restricted to the Armoured Corps flash and an Arabic number/ word on the glacis plate. As far as is known the Jordanian Al-Husseins have not taken part in any actions in the area. They appear to have retained most of their British layout down to the blue fire extinguisher body located on the turret rear (part of the NBC decontamination equipment carried by all tanks).



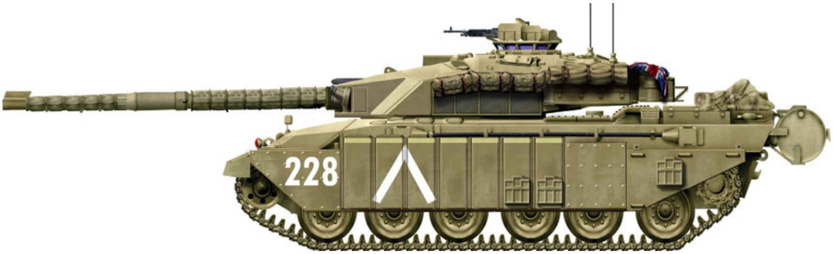


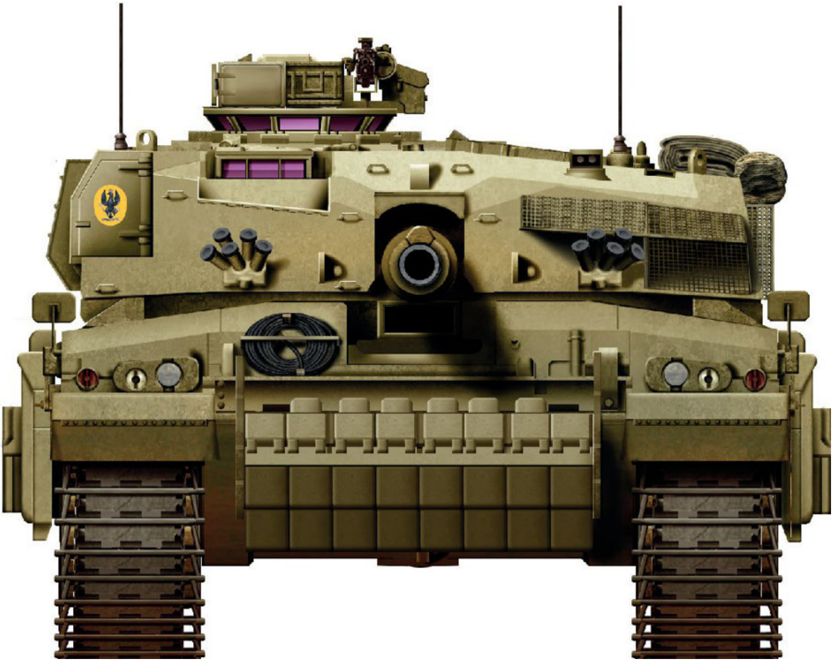


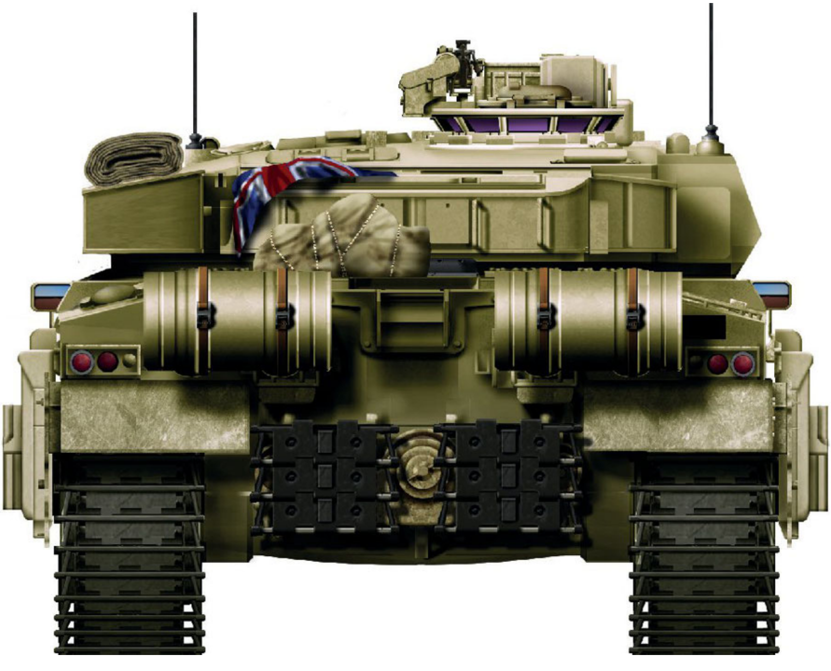


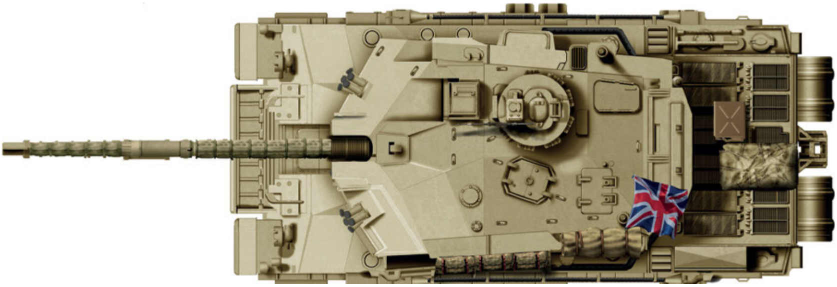
Challenger 1 Mk 3, 7th Armoured Brigade, Gulf War

These show a Challenger 1 Mk 3 from an unknown regiment as fitted out with the extra armour package. They obviously depict the tank before it was ‘customised’ by the crew as it is very tidy, and once the crew were living on it 24 hours a day its appearance would have changed drastically. It is finished in desert light stone, the shade of which is variable due to many things such as weather, how it was applied and the effect of sand removing it showing the green paint underneath. Very few markings have been applied, apart from the Red Jerboa (Desert Rat) on the TISH door, and the Coalition inverted chevron on the side armour. It carries the call sign of 11C. In action there would be amounts of kit stashed everywhere, usually secured to the vehicle with bungee cords; webbing would be located near each hatch and the camouflage net would be rolled and draped around the turret, making sure the optics were left clear.



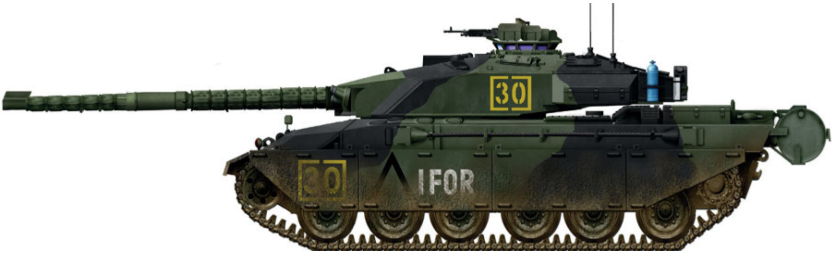


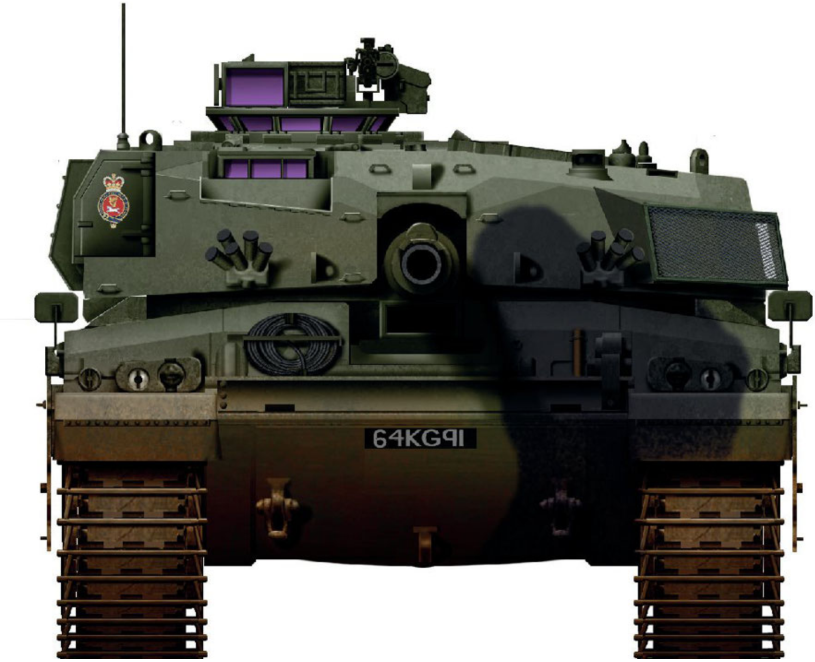




Challenger 1 Mk3, 14th/20th King's Hussars, Gulf War

The side view shows the typical layout of a Gulf War Challenger. The joy of not having to be aware of the effect of trees and branches tearing equipment from the vehicle meant that kit was stowed all over the place. This vehicle is painted in the light stone used for the Gulf War, although there are many versions that affect this colour including application batch and how it was applied, so no one colour will be 100 percent correct. Notice the revised tool stowage in the frontal view which was necessitated by the fitting of the ERA armour pack on the glacis. The application of the unit badge on the TISH door is a standard within units.Note the loosely placed Union flag on the top view. This would have been used in conjunction with coloured recognition panels to try to prevent the dreaded blue-on-blue incidents.

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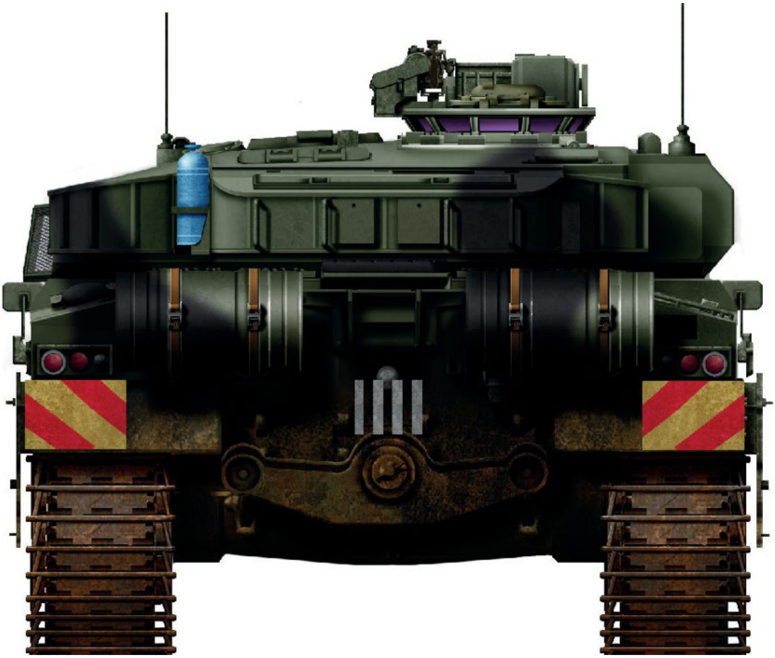
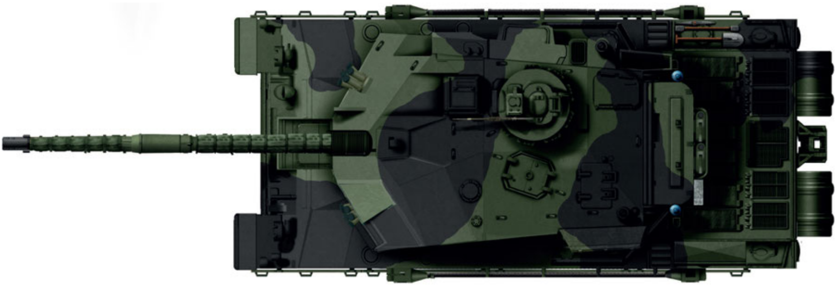
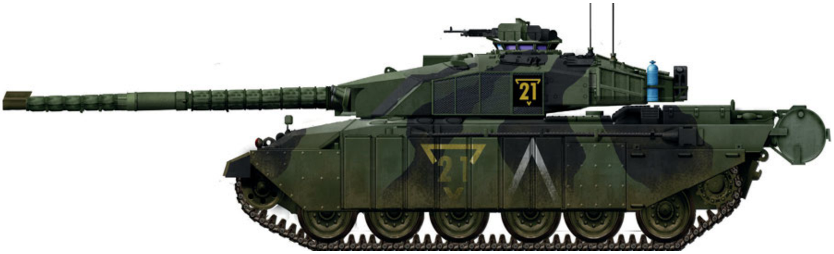
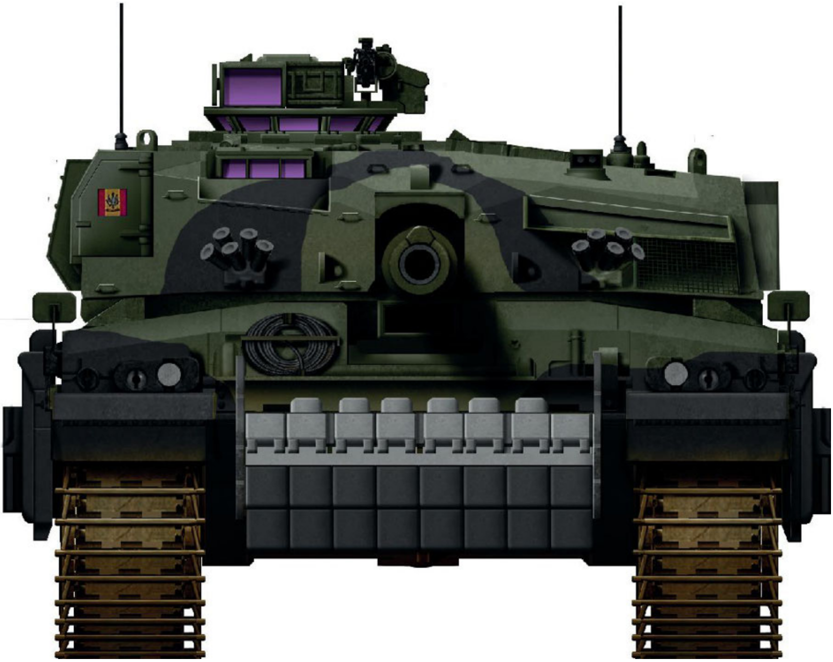


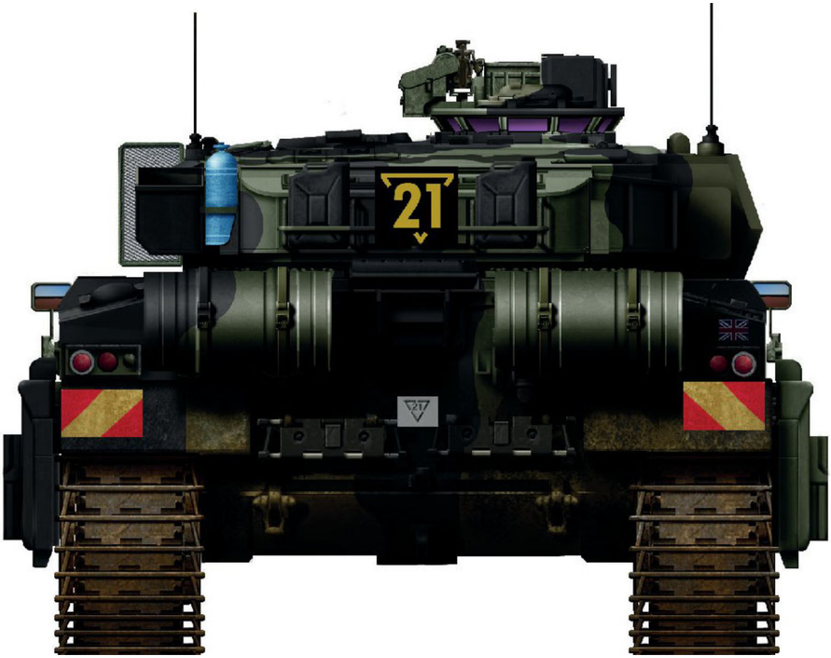


Challenger 1 Mk 3, Queen’s Royal Hussars

These images show the normal configuration for a Challenger 1 on operations in support of IFOR in Bosnia. The bazooka plates are the standard ones seen on the tank in regular service, but at each location there was a set of add-on armour for each tank that could be fitted if the need should arise. The regimental badge on the front of the TISH is that of the Queen’s Royal Hussars. The side view shows a well-worn and dusty appearance, which just about covers the Coalition chevron. The call sign indicates that this is the troop leader’s tank from 3rd Troop, B Squadron. The rear shows the two wide load panels on either side or one of the variants of the convoy sign. This one was in use for many years before it became standard practice to have the squadron tactical sign and call sign on them. The camouflage is the standard BAOR black/green pattern. The shape depends very much on the crew who applied it, as although somewhere an official pattern exists, it is never used, which is why most British tanks never seem to be uniform in their paintwork.



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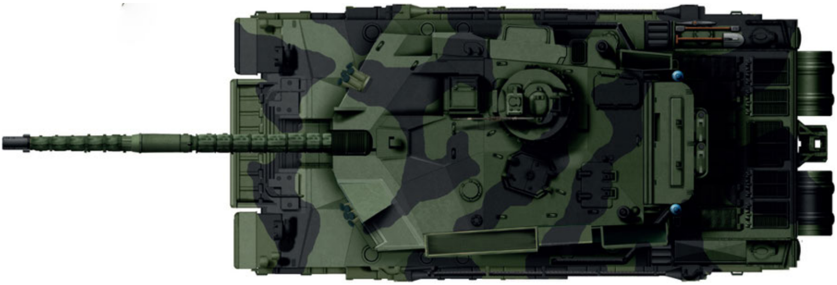
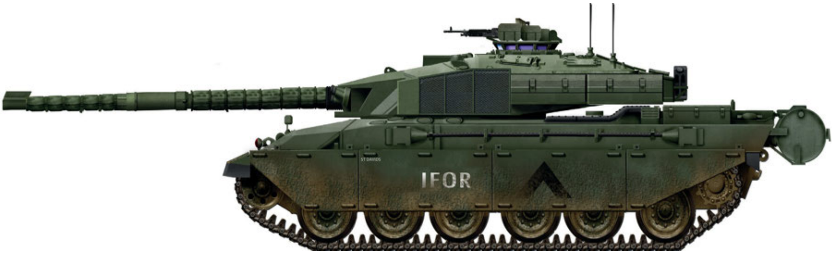
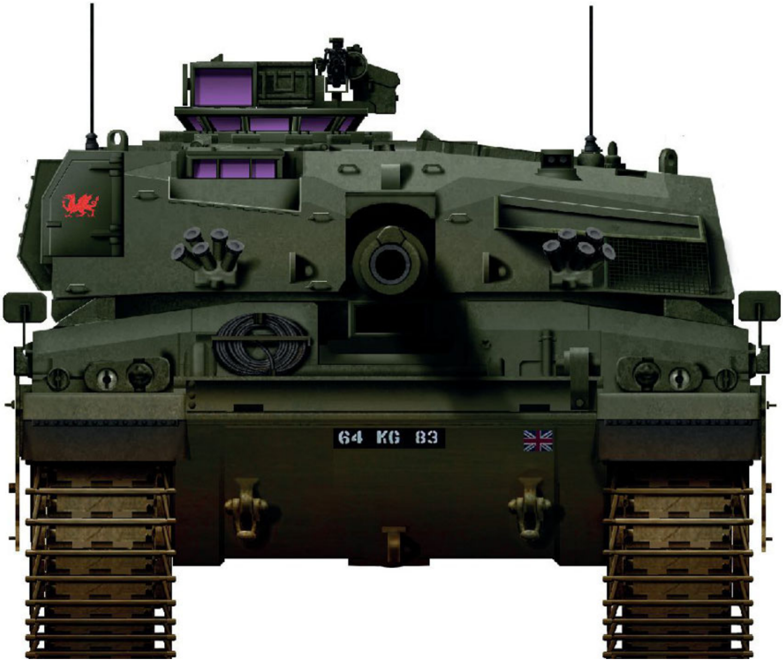


Challenger 1, 2nd Troop, A Squadron, Kings Royal Hussars

This depicts one of the King’s Royal Hussars’ Challengers involved in the KFOR operations. Normally the bazooka plates would have had the KFOR letters painted on the side, but this one has a Coalition inverted chevron. Very noticeable is the tank’s individual radio call sign painted onto the turret side and the bazooka plates, this does help identify individual tanks when operating closed down. The call sign is painted on top of the tactical symbol for A Squadron. Some units have this, while others have the triangle in the normal orientation. The 21 means that it is the troop sergeant’s tank from 2nd Troop, A squadron; B squadron would have a square and C squadron a circle. The tank is painted in the familiar NATO green and black disruptive camouflage, and also sports the regimental badge on the TISH door.

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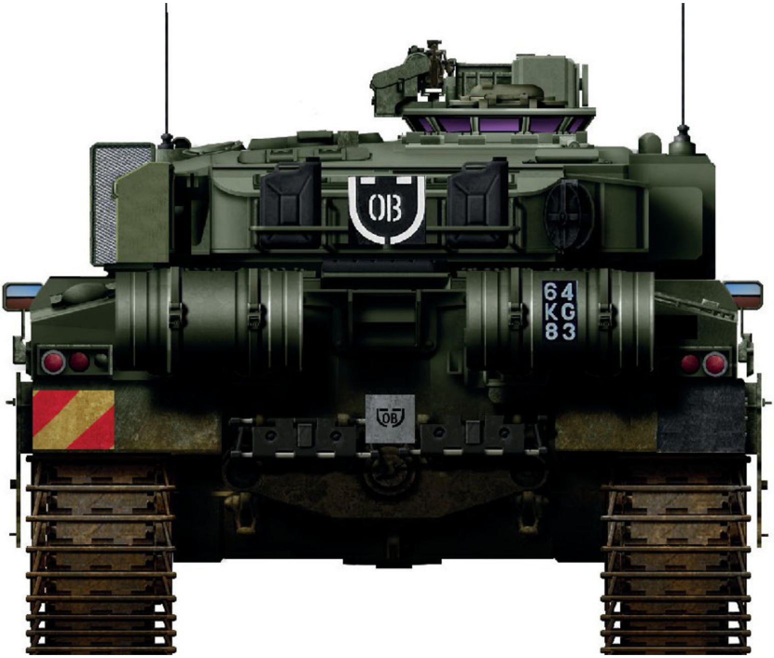
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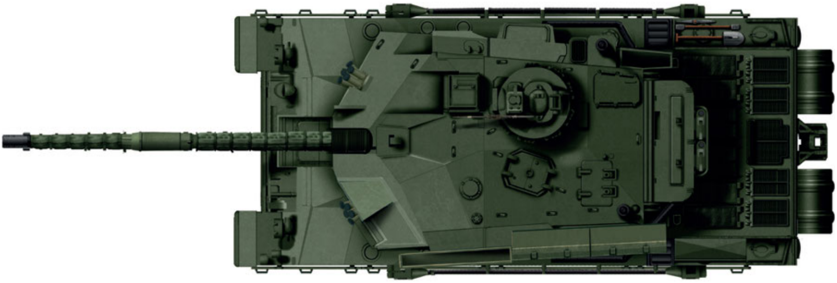
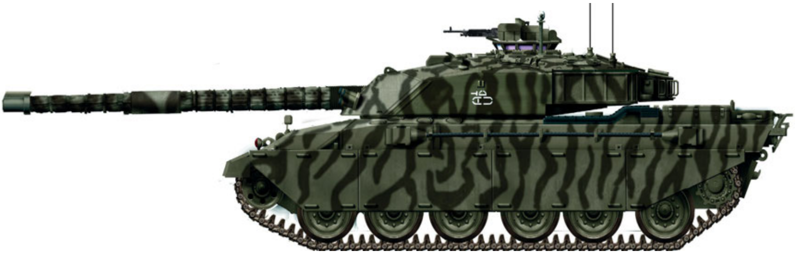
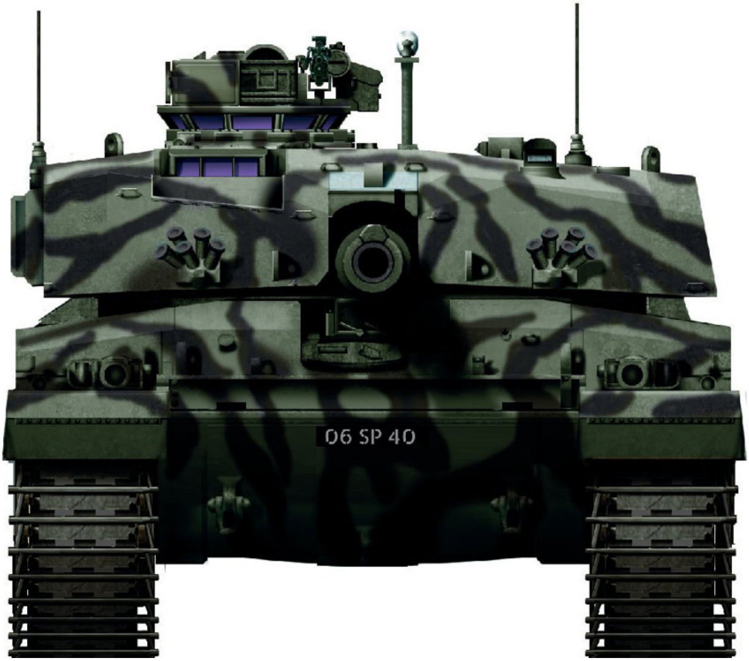


Challenger 1 Mk 3, Squadron Leader, 1st Queen’s Dragoon Guards

This tank belongs to the Squadron Leader (a major) of D Squadron 1st Queen’s Dragoon Guards, known as the ‘Welsh Cavalry’. It is a Mk 3 but not really distinguishable until you climb inside. Points of interest though are the Welsh Dragon on the TISH door and the wide load panel on the rear wing, although there would also have been one on the other side. The call sign indicator belongs to D Squadron which was sometimes the fourth Sabre Squadron in a regiment; it is denoted by a D turned onto its side. Looking lower down on the rear hull the same symbol can also be seen, but a lot smaller. This is the convoy light which is used for night driving, when the tanks use no lights at all (to enable following vehicles to see the preceding tank a small light is located low down, but it is often very hard to see when following it). It can be painted as in the drawing, or as a small white square; originally it was a white square with vertical black lines. Also on the front of the tank is the normal style of British Army vehicle registration number and a Union flag: this would also be repeated on the rear right wing. The vehicle bridge classification would also be painted onto the lower glacis plate, usually in a grey circle with black numbers, but units have their own style and preference of paint colour.





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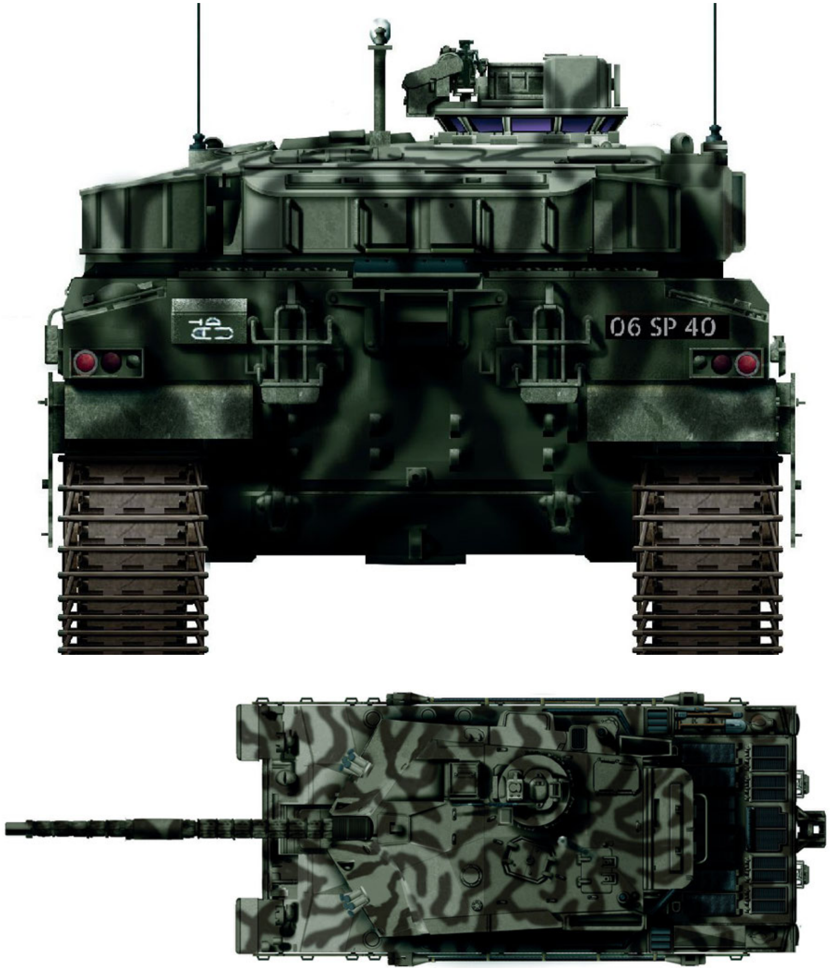


Challenger 1 Prototype

This is a Challenger 1 prototype, showing a rather distinctive camouflage pattern, which would certainly brighten up a model. The vehicle was taking part in a major firepower and defence-sales demonstration held at Lulworth Ranges in Dorset, United Kingdom. The crew from the armoured trials unit applied the tiger strip pattern as a trial and as well as to see what reaction they could get. Not long after it was repainted to drab green. Apart from that it was a normal Challenger 1 prototype.

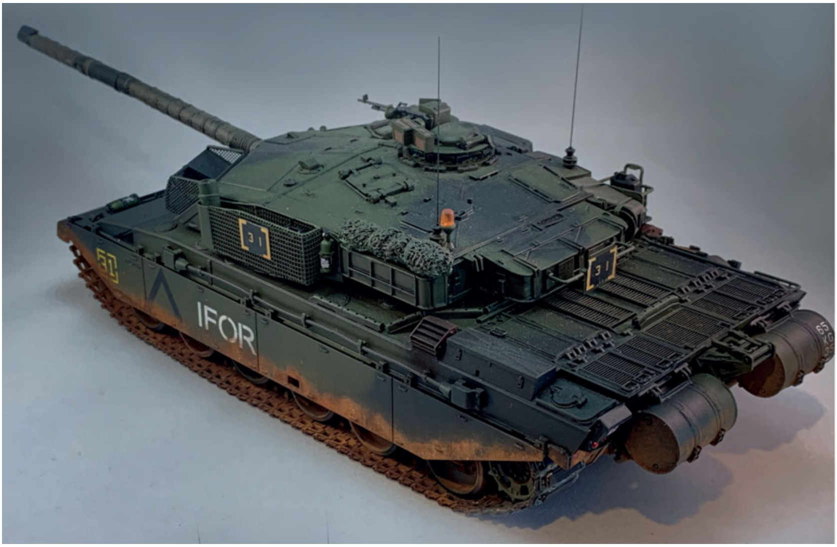
Challenger 1 MK 3

British Royal Armoured Corps,

IFOR, Kosovo

1/35 Scale

Paul Crocker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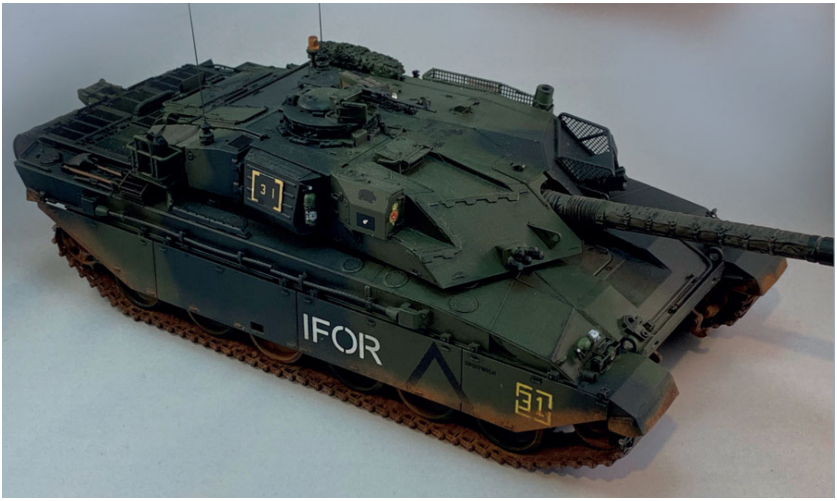
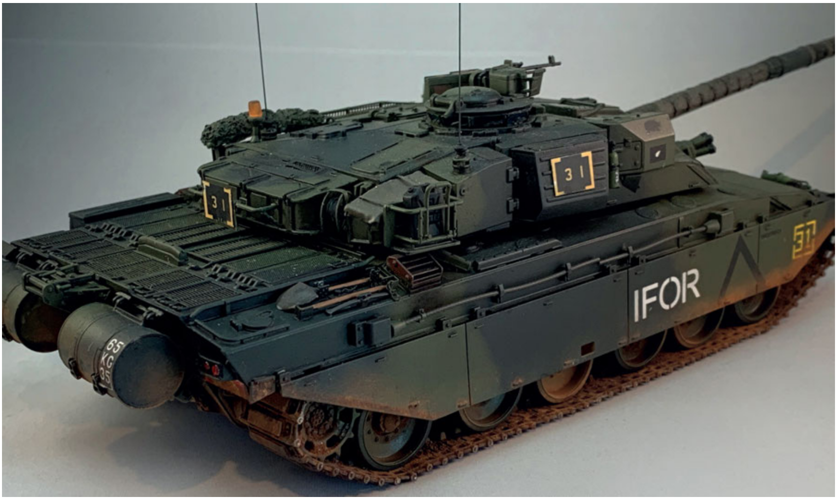
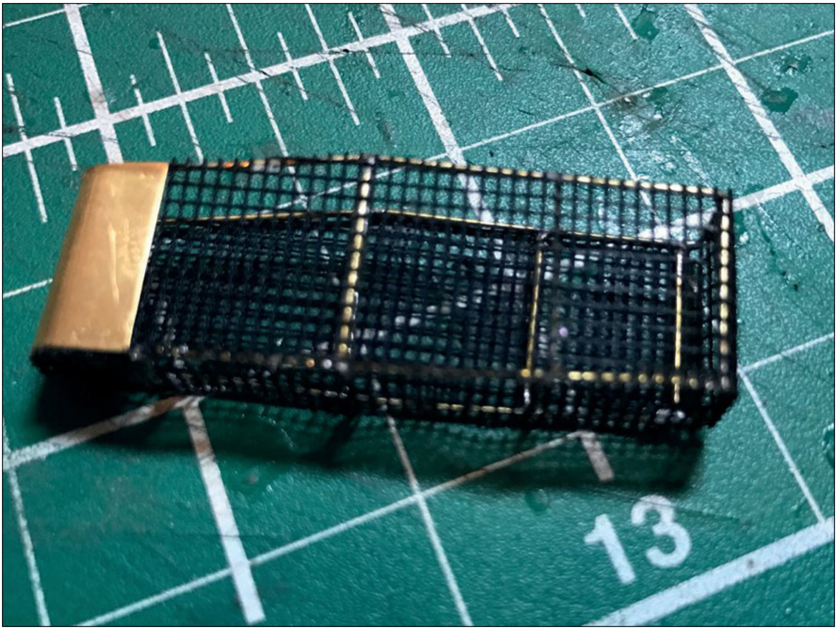
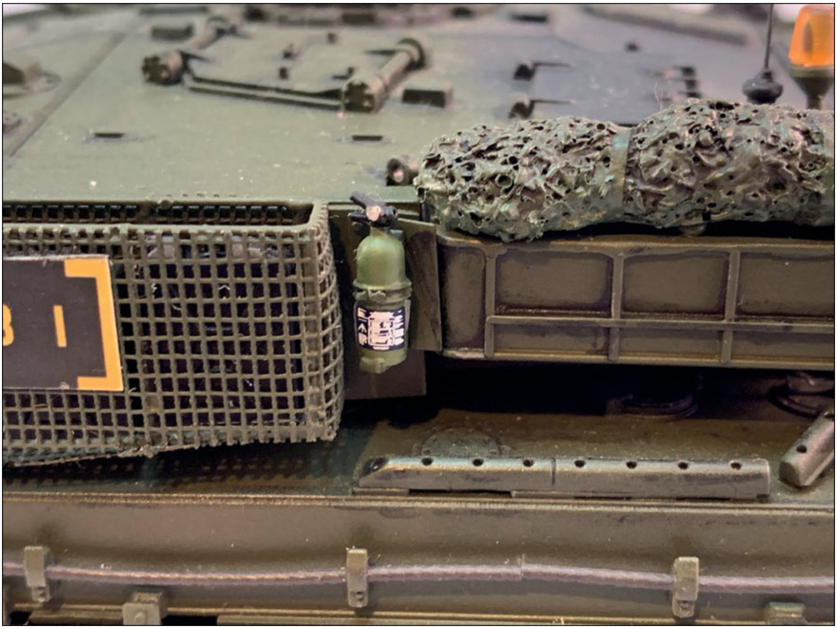


This is a 1980s Tamiya Challenger 1 Mk 3, before the newer up-armoured kit was released. It is vintage Tamiya despite its age, a real 'shake and bake' kit. Although this model has plenty of aftermarket products added and some scratch-built items, it is possible to build this kit straight out of the box and have a decent model to show for it. The assembly and fit is good with a moderate level of detail in the moulding.







The mesh bin is scratch-built from brass rod and brass sheet and Tamiya mesh from the spares box. The camo netting was purchased separately *online, although it's good to know that Red Zebra does a range of camo netting. The fire extinguishers are Accurate Armour Modern British Fire Extinguishers (Green Scheme) (A079).*

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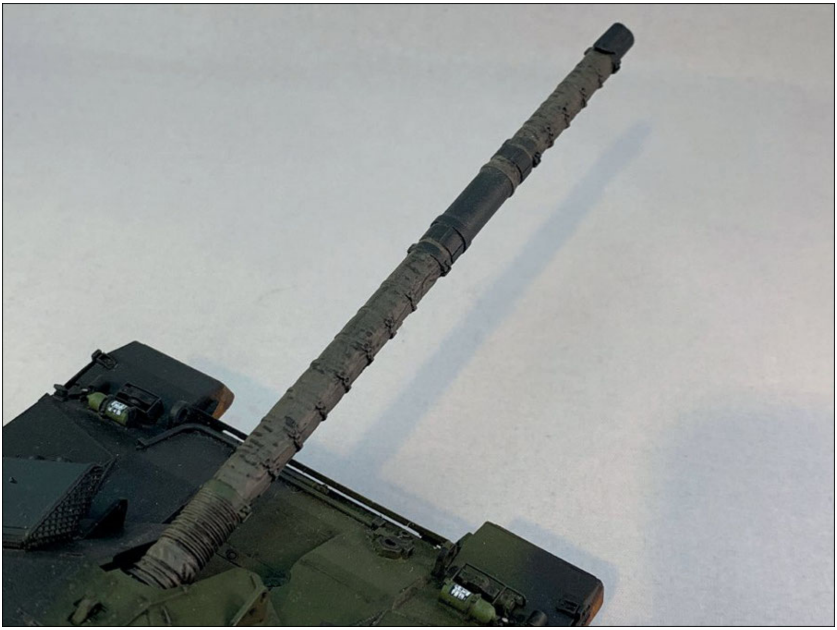
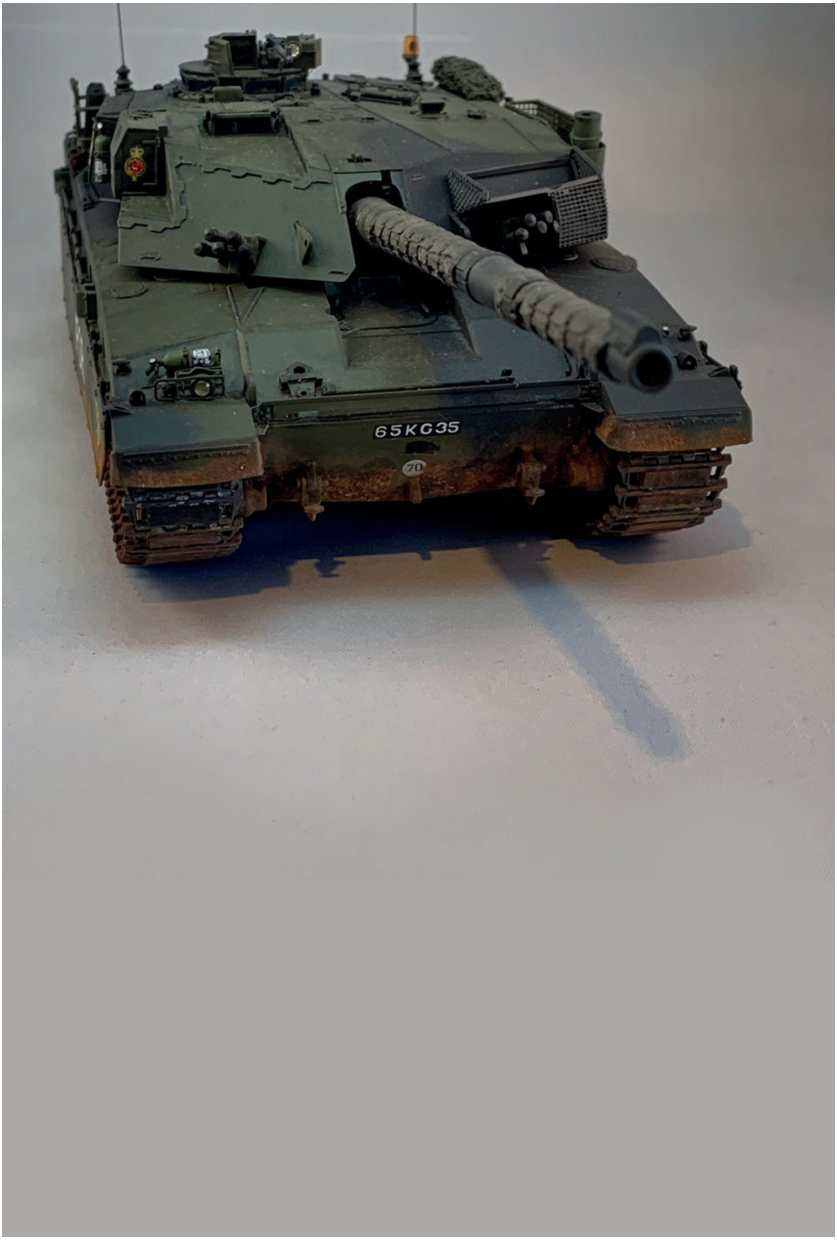
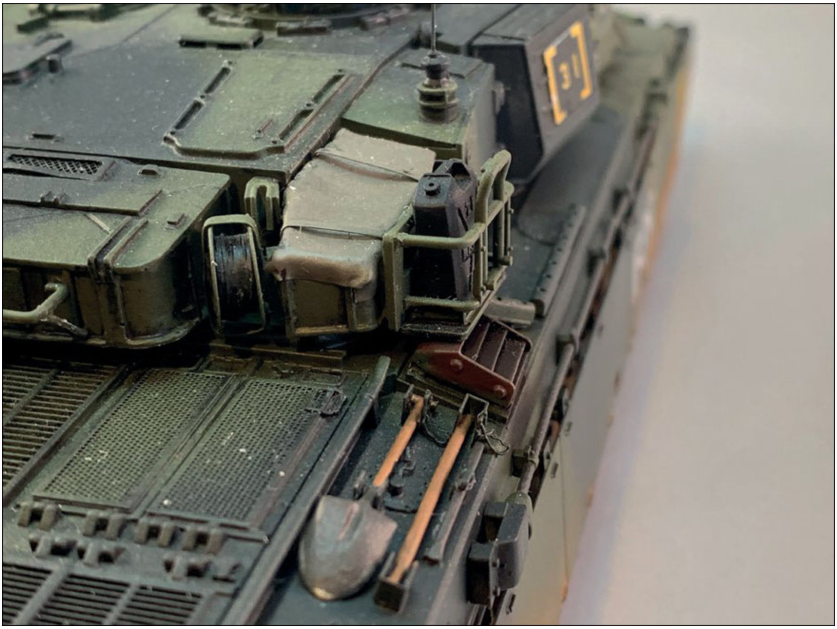


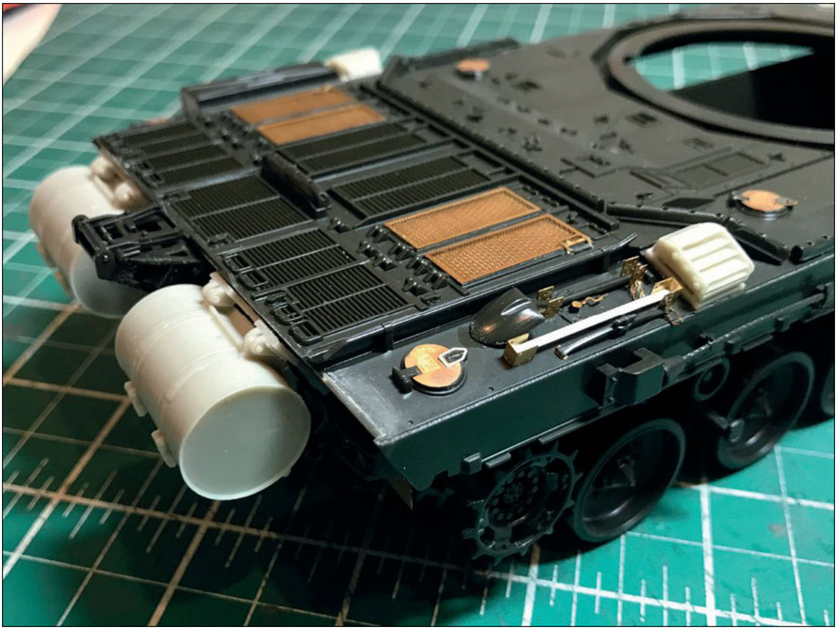
The gun barrel is an Accurate Armour resin UK 120mm Chieftain L11 MRS Gun (B35011). These old kits did not benefit from slide moulding so the seamline on the barrel is pronounced but not unworkable. With time and sanding it can be whipped into shape.



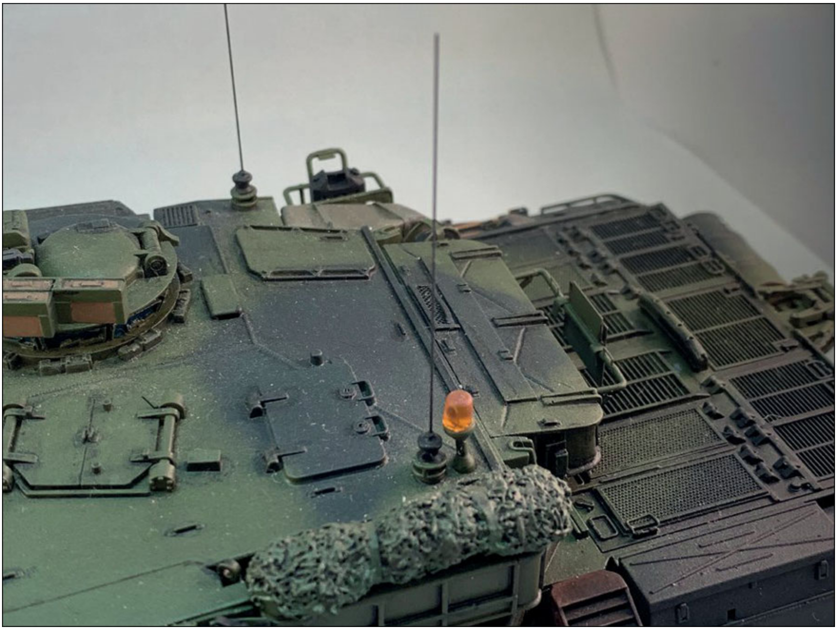
The kit exhaust grilles are too small and don't sit prominently enough so Accurate Armour (Challenger 1 Correction set) grilles were used. The rear fuel drums are also Accurate Armour additions (C020).



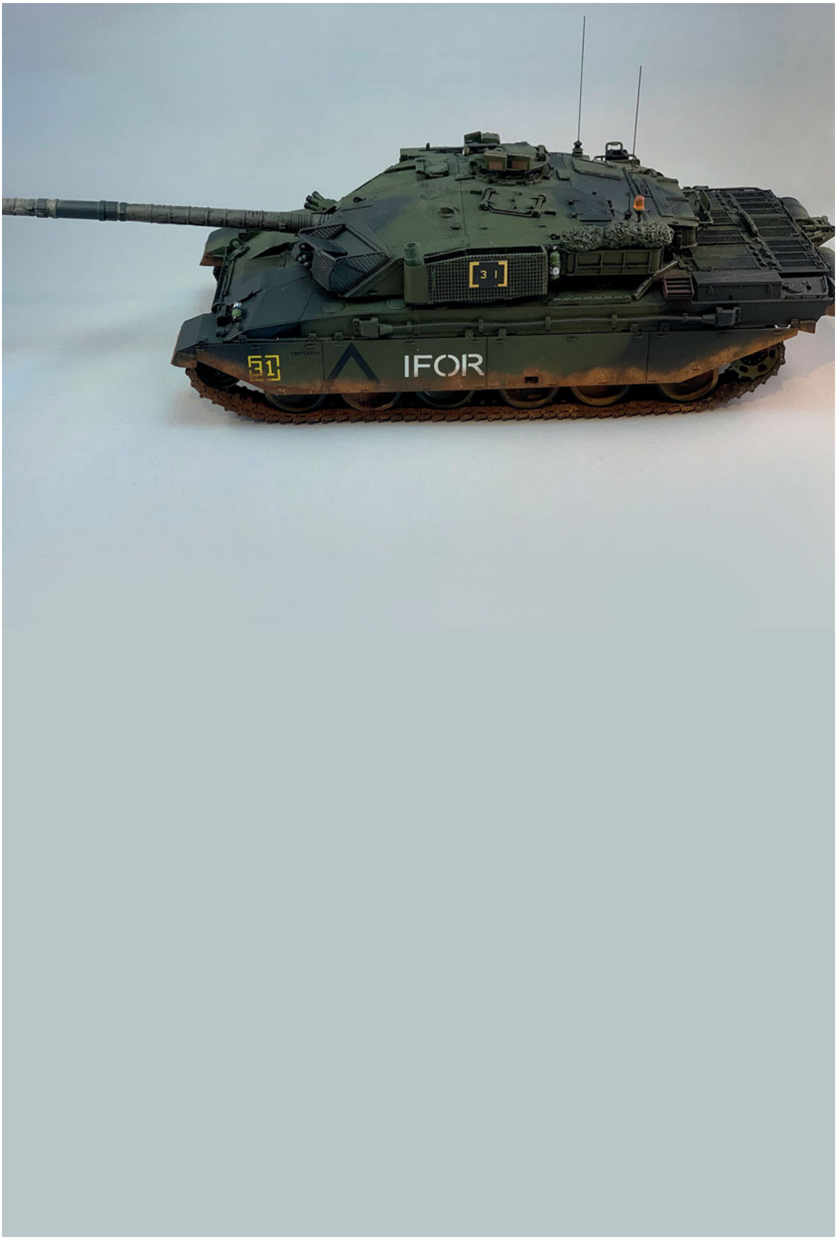
The rear bin's cover and straps are lead foil and the D10 reel is Eduard photo-etch with cotton wound around the reel to look like cable. The rolled mat and jerry cans are also from long-forgotten kit parts in the spares box.



The pioneer tools are from the kit but the clasps and retainers that attach them to the hull are Eduard. Set 35332 also contains engine deck grills and other little detailed parts.



The antenna bases are from the kit but the antenna themselves are Accurate Armour carbon fibre rods (A094).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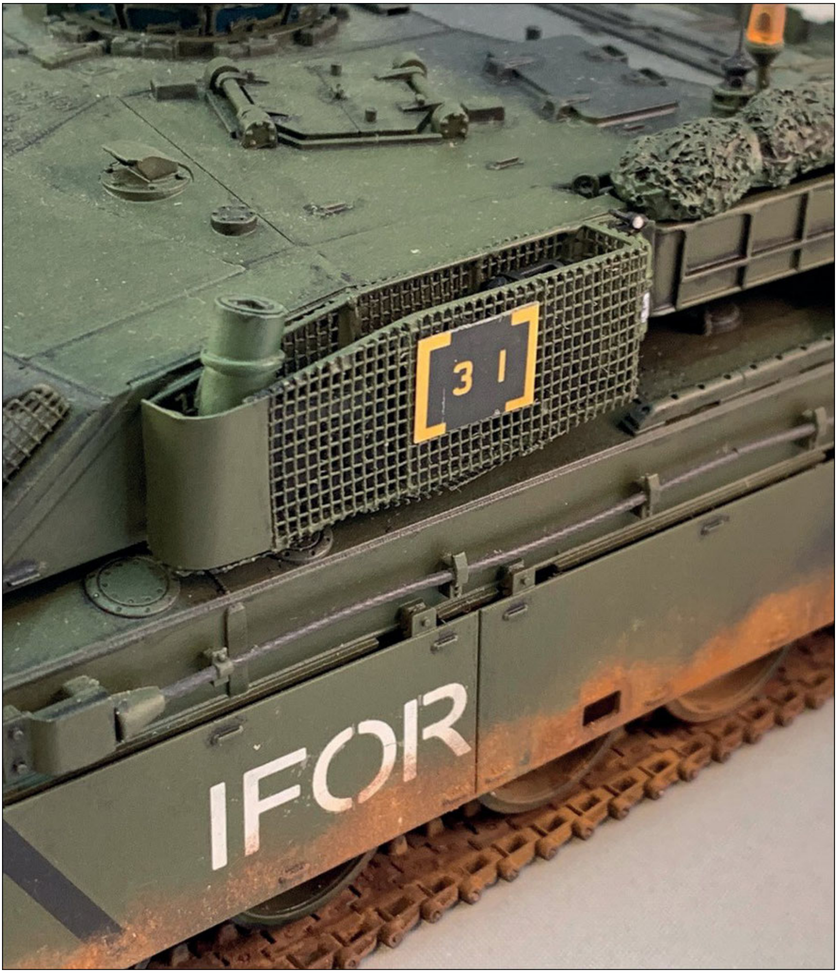
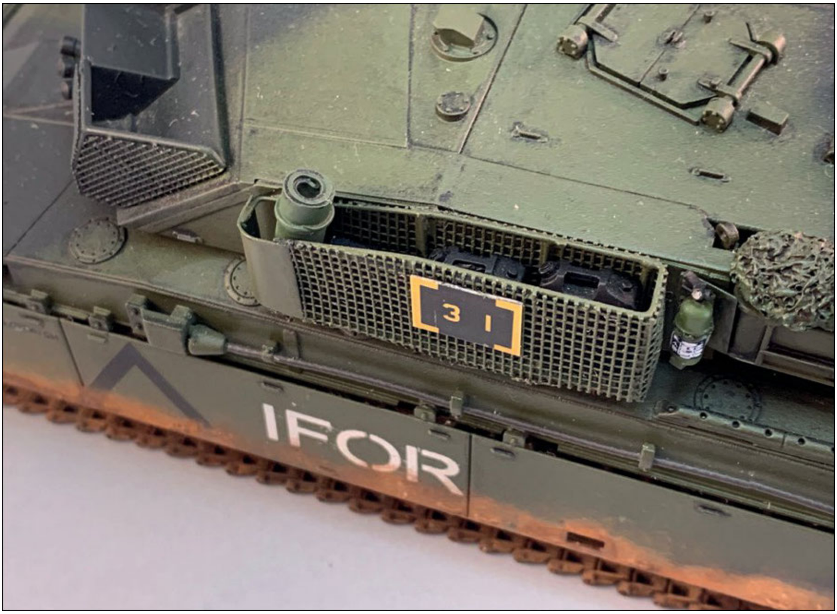
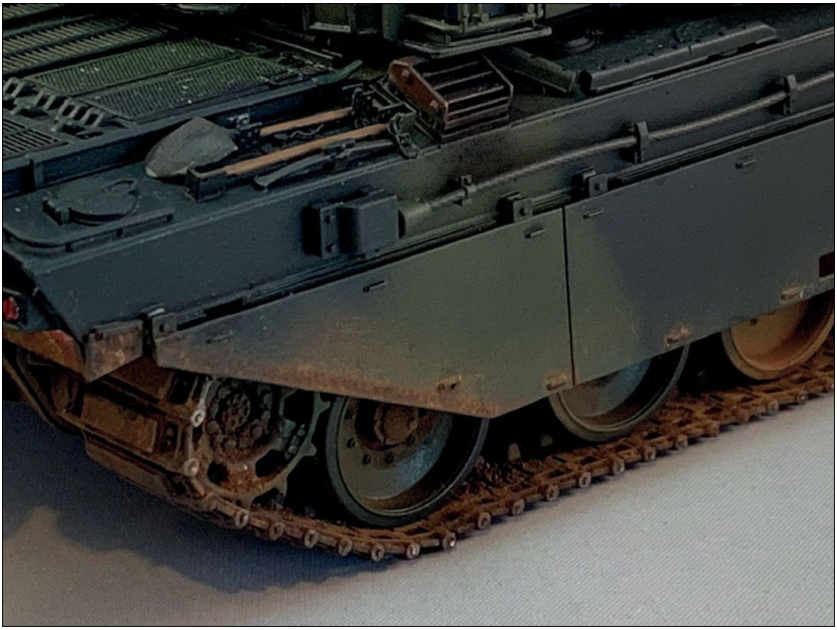


The kit elastic-band style vinyl plastic tracks have been replaced with Friul tracks (ATL-81 CHALLENGER 1 #89). There are 190 individual metal links that hinge together well to achieve a natural sag. The kit tracks will do if you're leaving the side skirts on but a more realistic track is definitely required if they have been removed. In this case, they just look better.



The decals are from Echelon Fine Details and although they're quite rare to find these days they do still pop up online from time to time. What's nice is that the set gives the option of the IFOR and KFOR operations.



The painting was done with MIG Ammo NATO green and black is still fairly popular although were this model to be painted today the Hataka HTK-A215 BS NATO (IRR) Green (BS381C:285) would definitely be used as the green is a much better match for modern British armour. Hataka also do a NATO black (HTK-A125 NATO Black (FS37030, AN44). Hataka paints spray much better than the Ammo paints and need half the coats. The weathering is achieved with a MIG Ammo dark wash and pigments. Pigment fix has been brushed on and while wet the pigment is dabbed on with a brush and built up in layers until the desired effect is achieved.

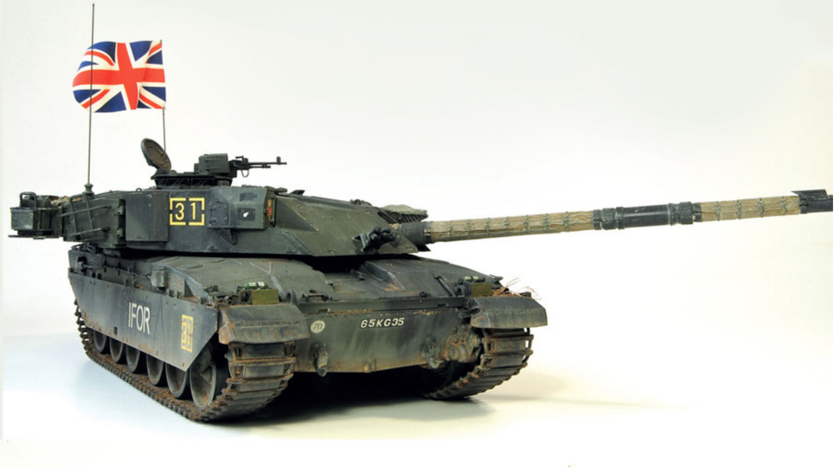
Challenger 1 MK 3

Queen’s Royal Hussars, SFOR,

Bosnia, 1996.

1/35 Scale

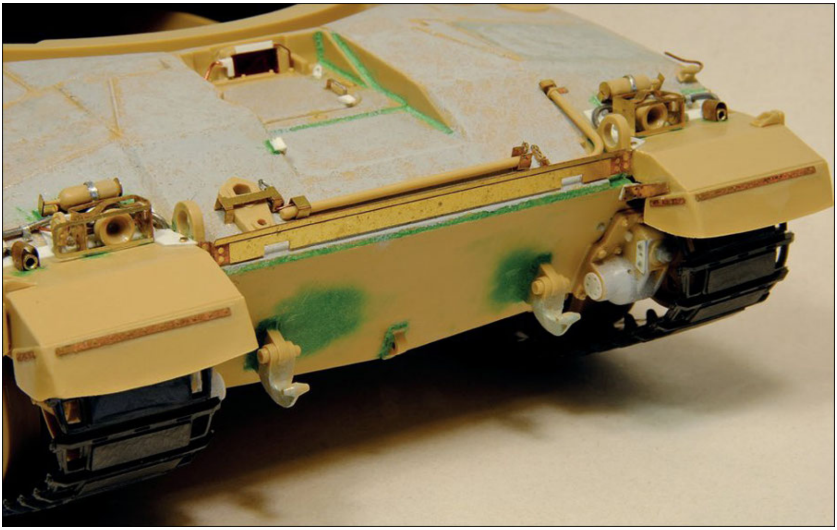
Brian Richardson



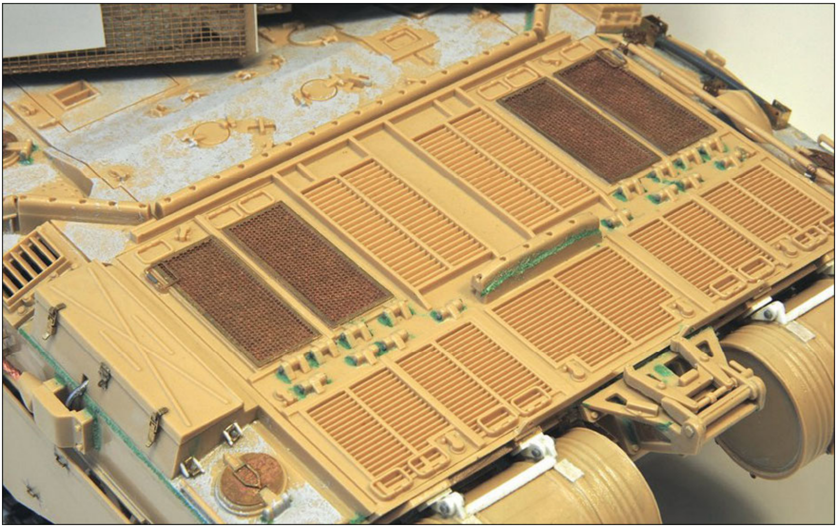
This model represents the Troop Sergeant, 3rd Troop, B Squadron, Queen's Royal Hussars (QRH), SOF Operation Resolute, Bosnia, 1996. It started with Tamiya's 1/35 #35154 Challenger 1 Mk 3 and I've added Eduard #35332 photo-etch, also Echelon decals #35002. Despite its age (released in 1992) this kit is basically accurate and can still be built into a good-looking model. Apart from adding PE, the main things I fixed were filling the hollow hull sponsons with 1mm card and I've added non-slip with Mr Surfacer using an old stiff brush. The rear fuel drum mounts have details added with strip and card as Tamiya have simplified these. They're much better on the Challenger 2 as this kit was released 11 years on.

Tamiya provided only two choices with their decals, one NATO and the other a desert version, and are quite adequate although there aren't any regimental details. This model has Echelon's decals as they provide specific details and much more variety with their set. The carrier film with these is quite thin and requires great care when handling to prevent damage.

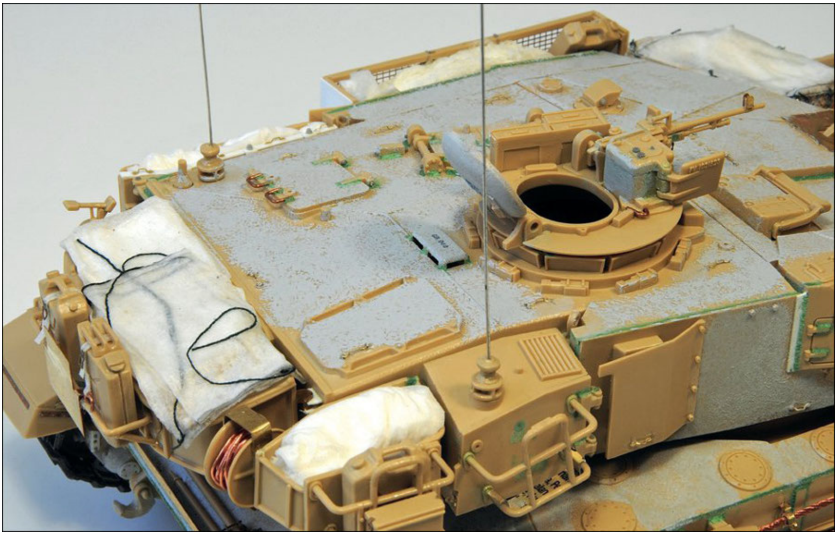
Replacement tracks would really help this kit although I've decided to use the kit-supplied ones on this build and let the weathering hide the mould line along their edge.



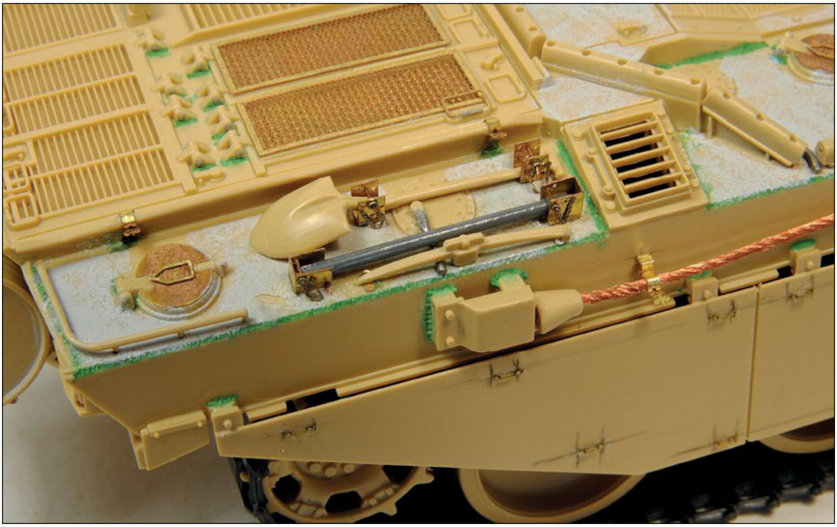
There's a couple of quite large sink marks in the vertical bow plate of the lower hull tub and these were filled with Squadron green putty although any other commercial brand will do the job just as well. These sinks are cause by Tamiya's method of moulding large mounting points inside the tub for joining top and bottom hull pieces, a throwback to motorization days as the hull underside lacks any detail and still has holes for the motor.



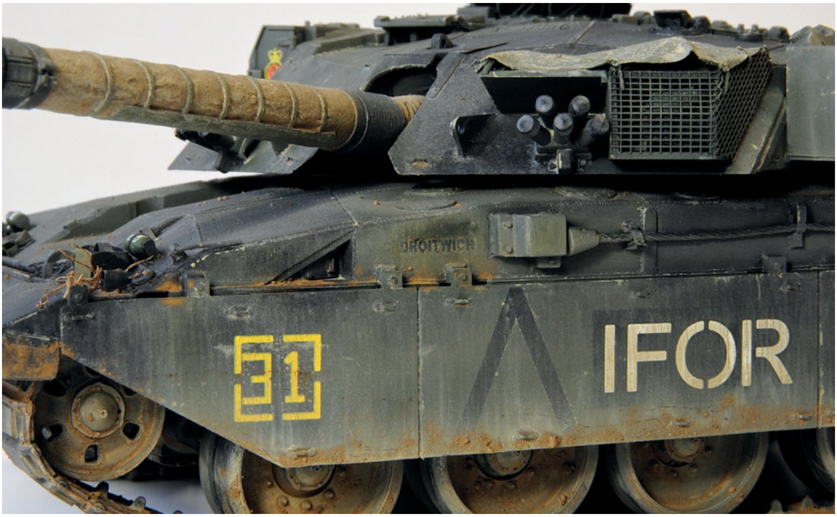
Lots of putty welds were added along with salami-sliced pins from stretched sprue for hinge detail around the engine deck.



All the tarps were made from rolled or folded facial tissue soaked in dilute PVA and positioned in the baskets before drying. This is my preferred method as it's too difficult to get a dried stiffened tarp into a *basket without doing damage. Painting them isn't that difficult as black pre-shading with the airbrush can reach into all the folds and careful application of thick colour washes can get into most places with capillary action.*



The kit's tow cables were replaced with braided copper wire for a more realistic look. The ends are cut off, drilled out and new cable inserted.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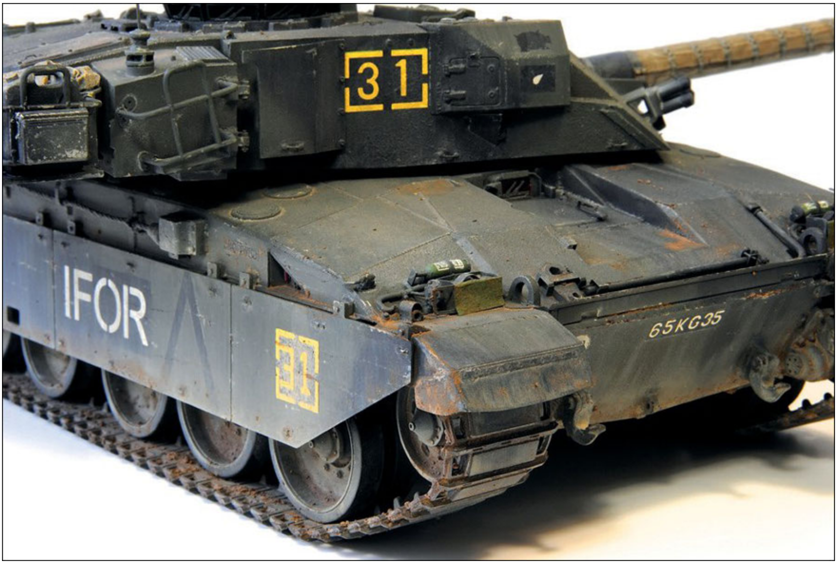
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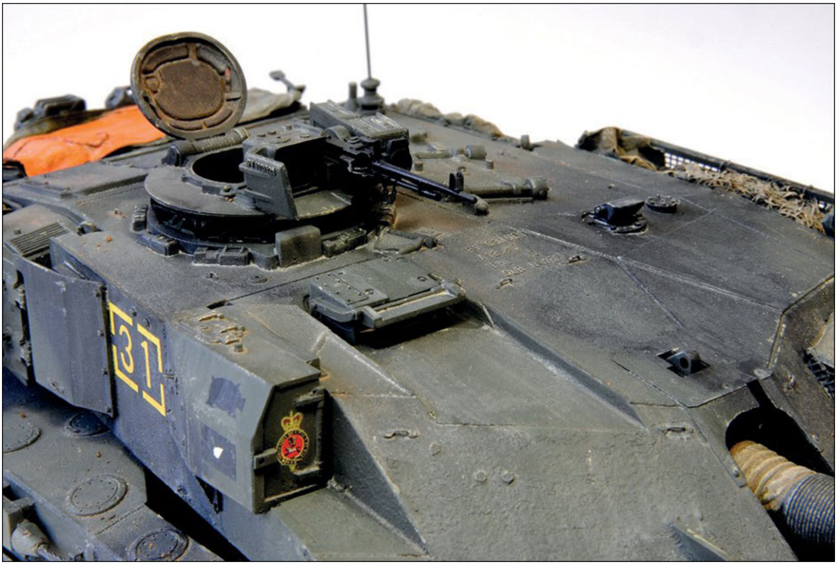
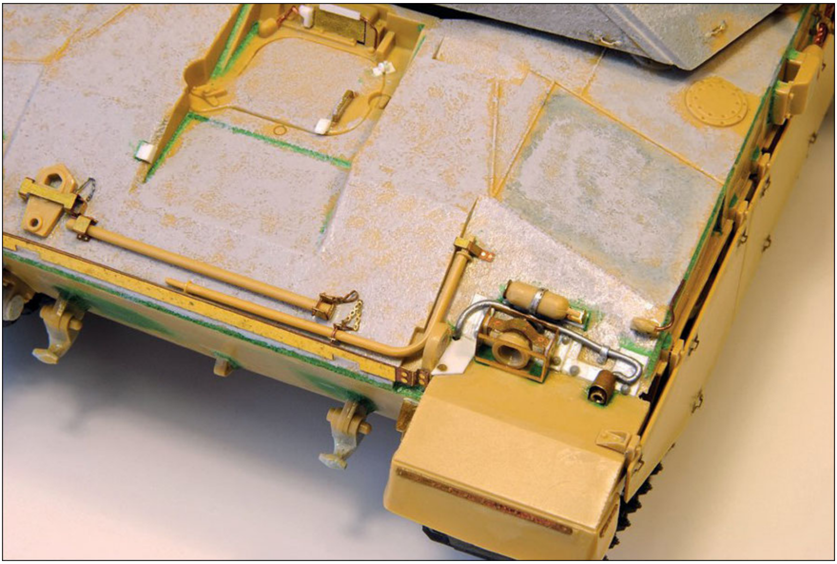
All tie down cleats along the side skirts and around the turret were replaced with etch. This is slow and tedious but I feel worth the effort as they really raise the level of added detail.

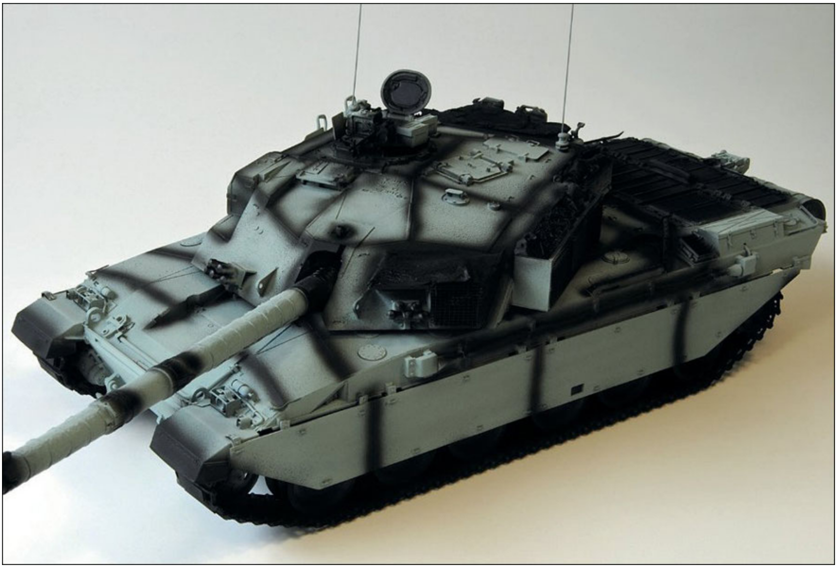


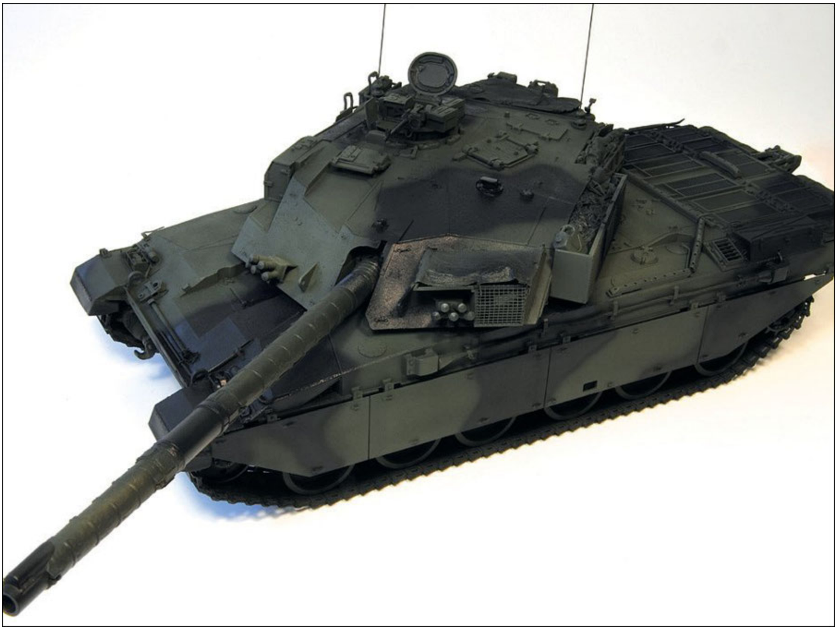
Tamiya provide a piece of clear acetate with pre-cut lenses for the driver's vision block and commander/gunner's sights only. The cupola vision blocks are moulded solid and have to be painted after the rest of the model is done. Paint the inside X25 Clear Green, fix them in place with PVA glue and then mask them off before exterior painting begins.

The Union Jack was printed on an Epson ink jet using fine paper. Two were printed with one reversed so they could be glued back-to-back with PVA.



The headlights were drilled out and filled with two-part clear epoxy after the final flat clear coat went down. Thin solder makes good electrical cables and were held in place with thin aluminium straps cut from food containers.





All major painting was completed with Tamiya acrylics staring with a blue/grey primer followed with black pre-shading. I've added a little XF-61 Dark Green to Tamiya XF-65 Field Grey followed with XF-69 NATO Black. A floor polish sealing coat goes down next, decals and another sealer over these. Weathering was done with oils, enamels and pigments, starting with a dirty brown/grey oil wash over the entire model. When this has dried a wide flat brush dampened with thinners is drawn down all sides creating streaks. This step gets repeated with different colours building up layers of dirt and grime. Next a few scuffs and scratches are added with a lighter version of the original colour using a fine tipped brush around edges and other high-wear areas. A thin mix of Tamiya Buff was sprayed over the tracks and lower surfaces to simulate dust followed by brown pastels clumped over the wheels and lower edges of the side skirts. After Humbrol flat clear seals everything in, graphite is applied to the tracks and a few edges. The masking tape over the lenses was removed and blackout covers were added to the headlight guards from tissue after I'd seen this feature in a reference photo.

Challenger 1 MK 3

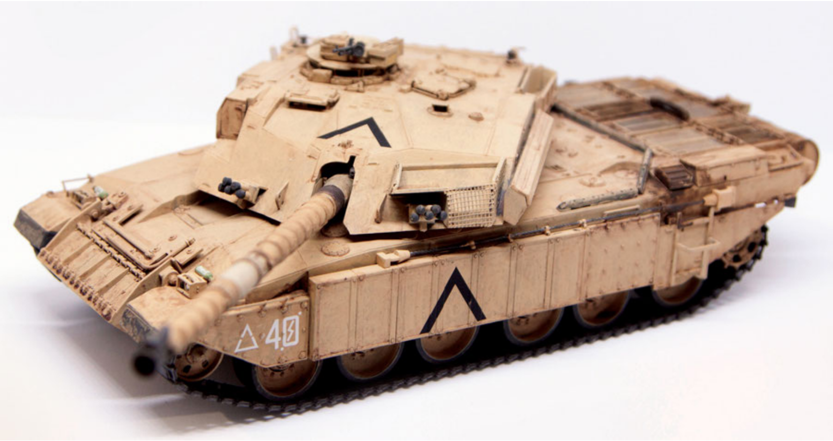
Royal Scots Dragoon Guards,

Operation Granby, Gulf War,

1991

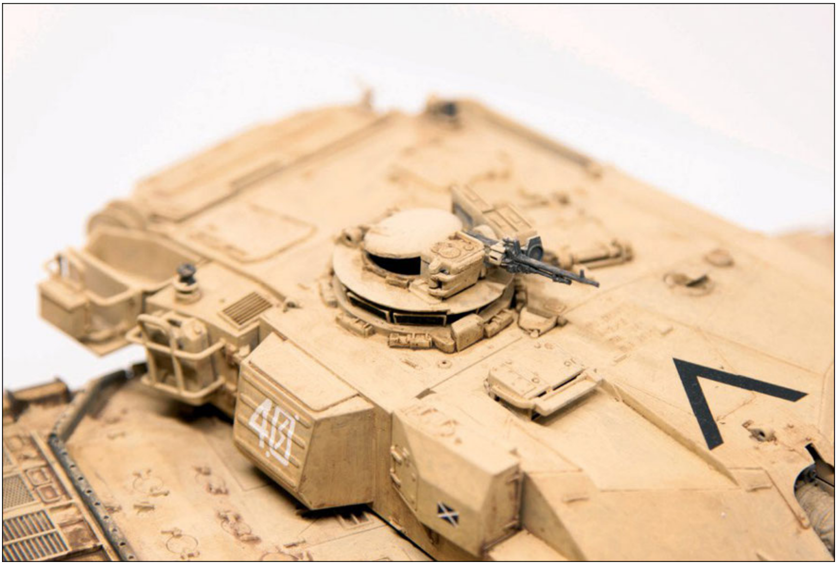
1/35 Scale

Steve Abbey

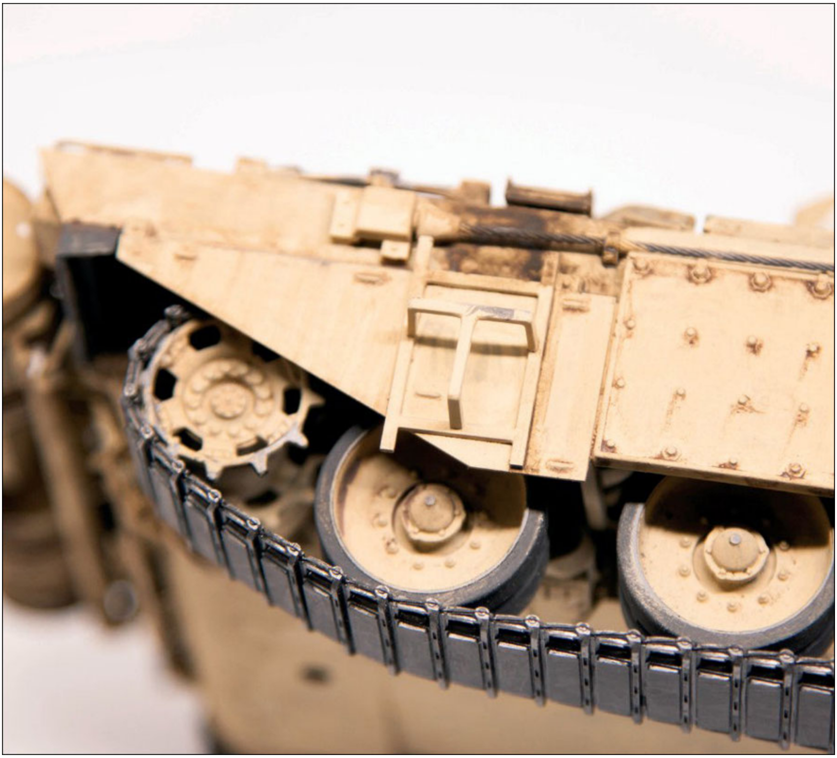


This is the 1/35 scale Tamiya kit of the Challenger 1 Mk 3 (35154), which is a re-boxed and upgraded version of the original 1986 tooling. An extra sprue has been added that incorporates desert upgrades, such as Chobham armour side skirts, reactive armour on the frontal area and improved exhaust shielding. With these extra parts in mind, it was decided to go for the more striking, sand-coloured ‘White 40’. This vehicle served with the Royal Scots Dragoon Guards and took part in Operation Granby during 1991. The less armoured, green and black disruptive-patterned NATO version can be built as an alternative.

The kit is typical from Tamiya, with clear concise instructions in 24 stages. Although in order to minimise mistakes, and after careful scrutiny, the prudent modeller may want to cross out the stages and items that don't appear in the chosen version. For instance, apart from the armour upgrades, there are two versions of gun travel lock. Clever engineering has kept the parts number down, while ensuring a good fit throughout.

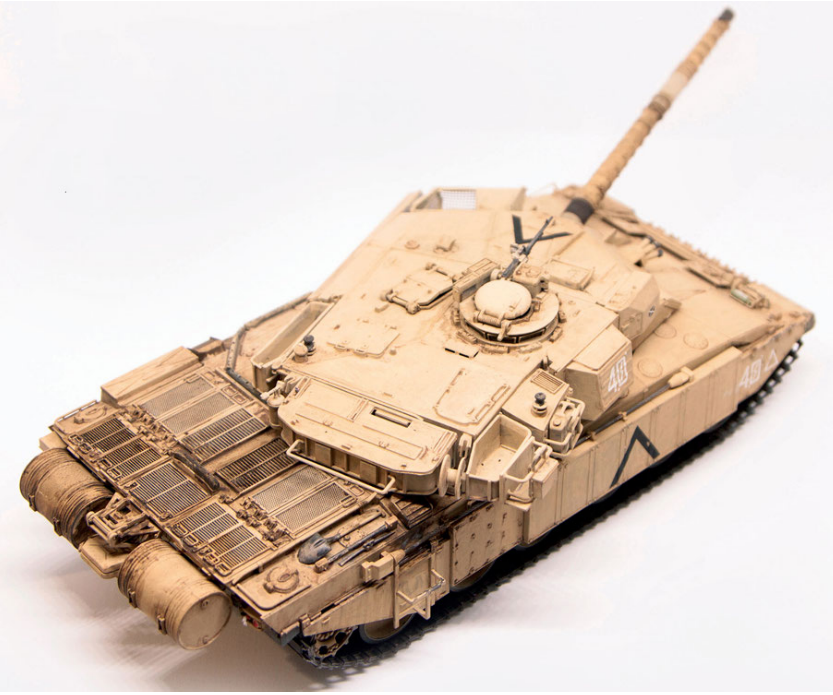


It was decided to build the kit straight from the box, without any additional aftermarket items. Initial construction started with pairing up the various wheels and sprockets. By utilising polystyrene tubes between inner and outer halves, Tamiya has enabled the builder to remove these for ease of painting.

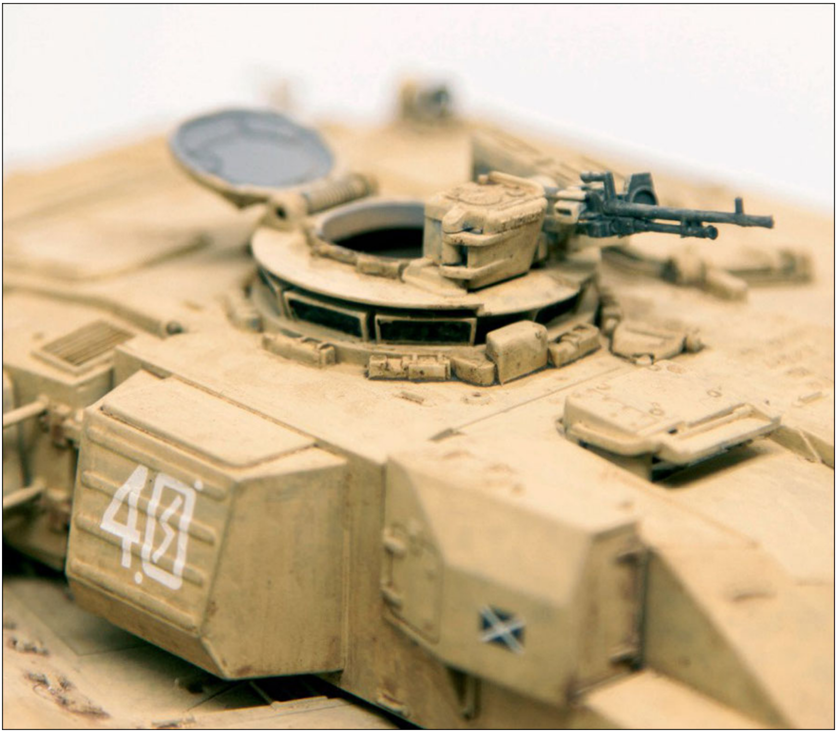


In order to form a solid base for adding smaller parts, after stage 2 the instruction sequence was ignored and moved to stage 8, where all the parts for the inside of the upper hull were added. The upper hull was then firmly glued and taped, along with the rear panel, to the lower hull. The instructions were then followed from stage 3. This method ensures that the smaller parts are not accidentally broken off when trying to put together the larger parts.

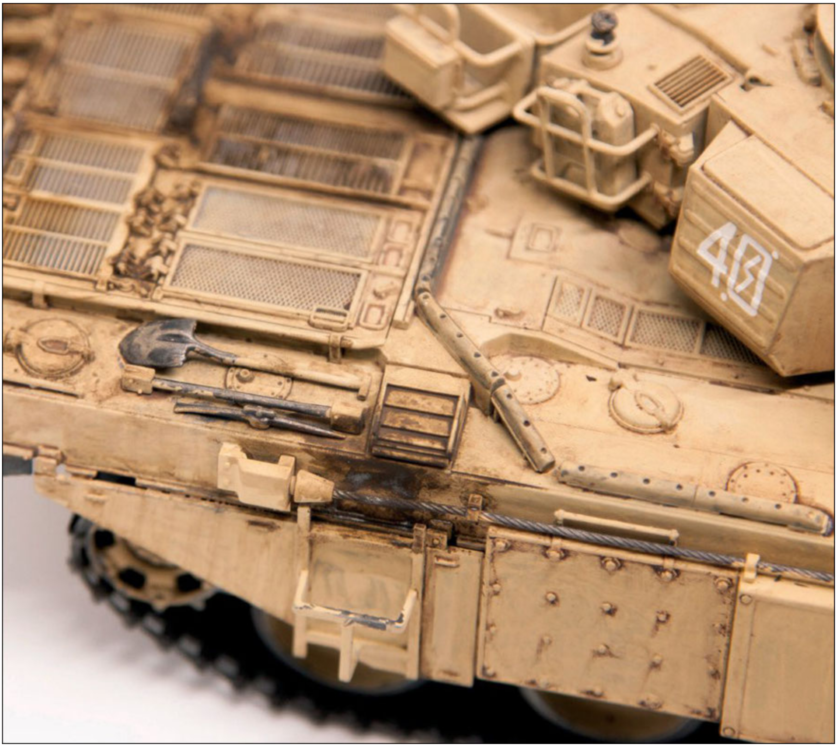
Rubber band tracks are not to everyone's taste. However, they do adequately portray tracks under tension. After stapling the ends of each track together, the top joints can be conveniently concealed behind the armoured side skirts. The metal work was painted with Vallejo steel, whilst leaving the track pads dark grey rubber. Afterwards, both tracks were treated to a wash of AK Interactive Tracks Wash.



Before painting, the model was primed using Halfords Grey Primer. This enables any imperfections to be corrected and hides any surface texture changes when adding etched parts or filler. Due to a malfunctioning airbrush, it was decided to use a Tamiya aerosol – in this case TS-46 Light Sand. To create a slightly worn, patchy finish, Tamiya XF-59 Desert Yellow was roughly painted on in a random manner. A watered-down wash of this colour was used on the rubber mudguards and tyres after they were painted Lifecolor UA734 Worn Black.



The areas where the decals were to be placed were covered with a layer of AK Interactive AK192 Glossy Varnish. The kit decals used were for ‘White 40’, a vehicle which served with the Royal Scots Dragoon Guards and took part in Operation Granby during 1991. After a few minutes soaking in warm water, they adhered to the model with no problems.



The model was weathered using AK Interactive AK2019 Engine Oil – particularly over the engine grilles, AK2073 Paneliner for Sand & Desert Camouflage – over the bolt heads and main gun sleeve, and Lifecolor UA 263 Grease Effects-around the filler caps.

Finally, the complete model was sprayed with a matt coat using Tamiya TS-80 Flat Clear.

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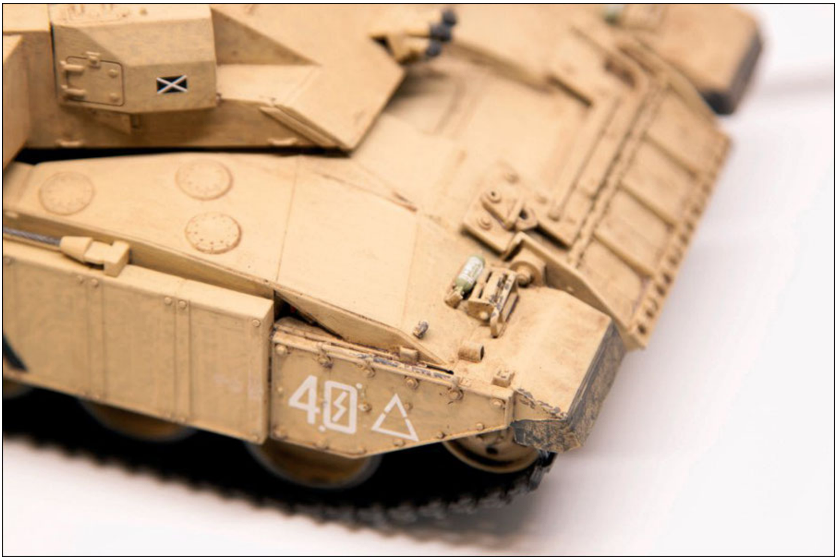
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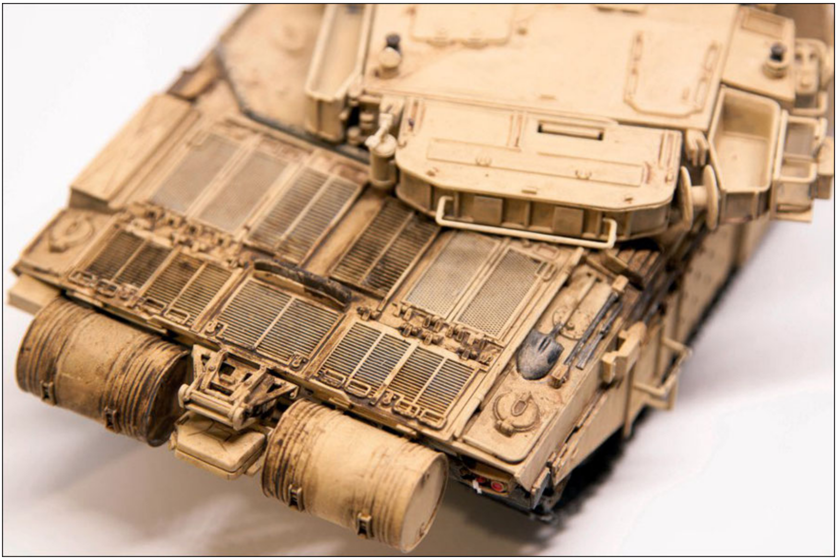


Challenger 1 MBT

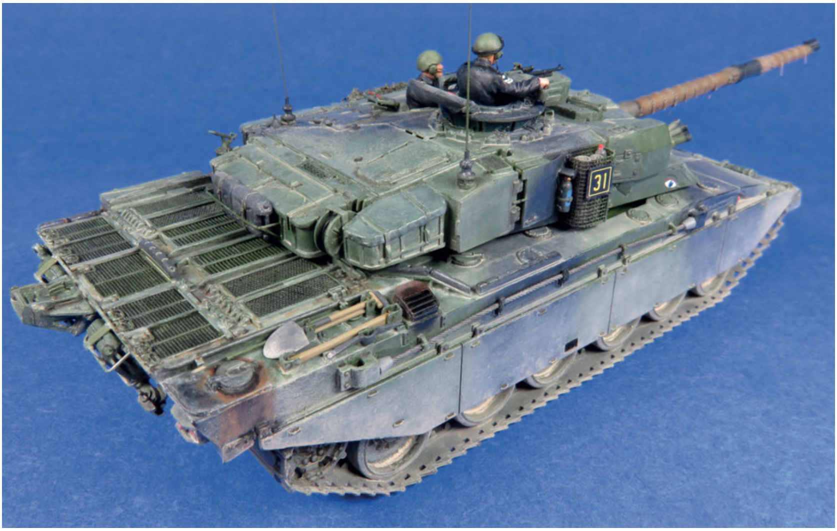
1st Royal Tank Regiment,

Salisbury Plain Mid-90s

1/72 Scale

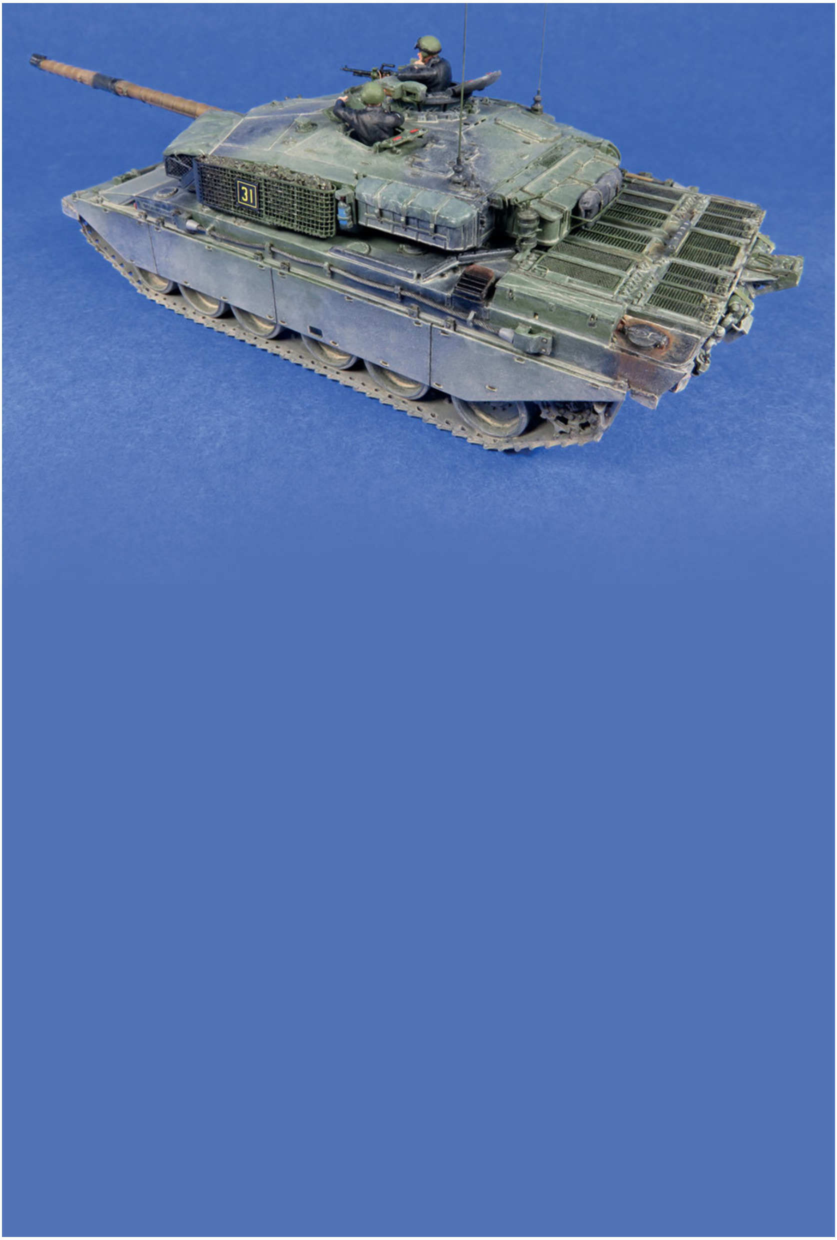
Timothy Neate

Back in 1983, just after Challenger 1 entered service with the British Army, I scratch-built a 1/76 scale model of Challenger based on the Airfix Chieftain kit. Thirty-six years later I thought I would build another Challenger 1, this time using Revell kit No 03120 produced in 1998 and the more recent Trumpeter kit No 207106 released in 2011. The model is based on a 1st Royal Tank Regiment Challenger called ‘Dreadnought’ in service on Salisbury Plain in the mid-90s. After considering which kit to use I decided on the Trumpeter one because the handling of the detail was more to my liking.

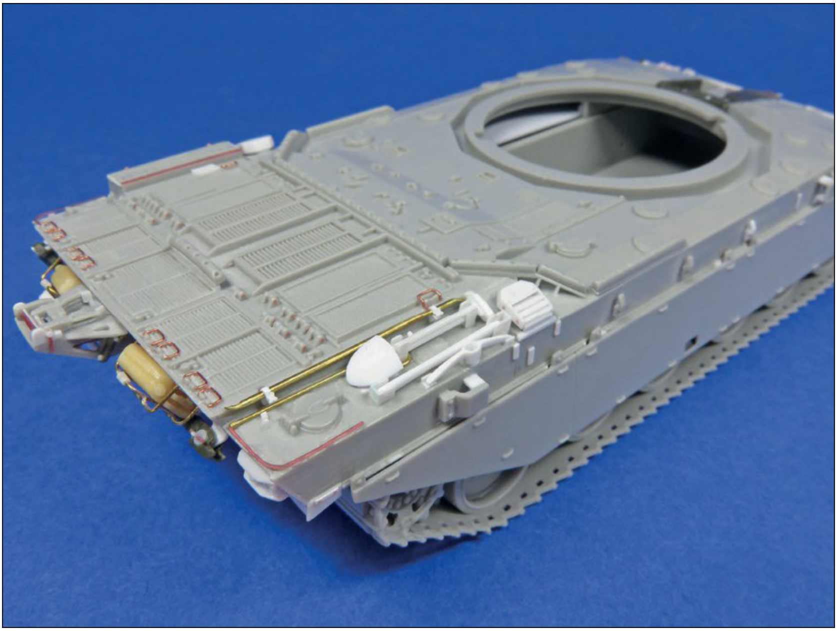


One of the big drawbacks of the Trumpeter kit is that all the crew position hatches are moulded closed. As I planned to have crew figures, all these required opening up. The Revell kit has an open driver’s hatch and commander’s cupola, so it seemed reasonable to use these, although the driver’s position required some careful cutting and fitting to a make satisfactory transplant. Using black plastic card, I constructed a box beneath the newly transplanted driver’s position to allow a head-andshoulders figure to sit in the open hatch. The re-detailing of the hull started at the rear with mud flaps, lights, towing eyes, spare track link holders and the tow bar equipment modified from the Revell kit.

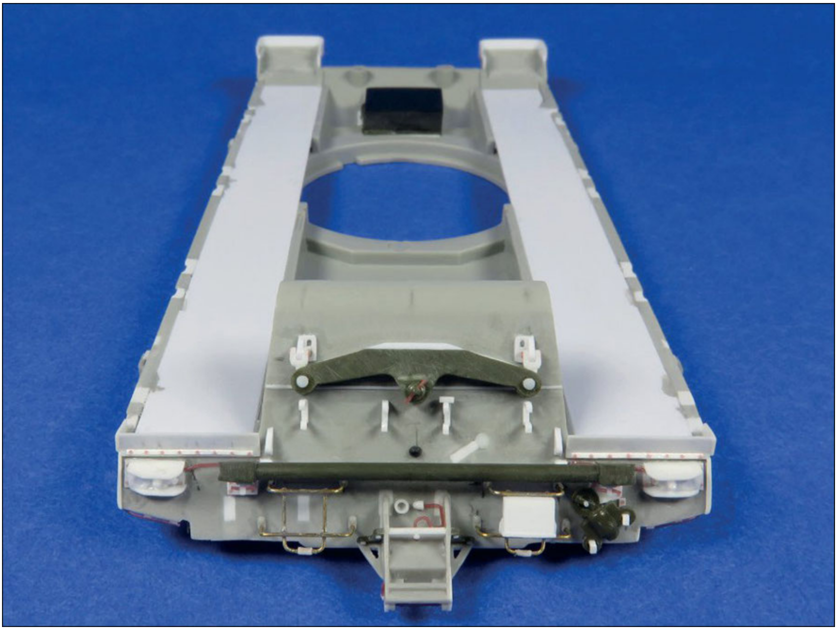
The two Jerry can holders were shaped from brass rod and soldered for strength, with the first aid box attached to the left-handholder. The gun clamp was refined and defined with a couple of parts from Revell. One of the scratch-built fire extinguishers is mounted behind the large side basket and the modified grease pump, with the dispensing hose coiled around the drum, is attached to the side of the Revell rear bin.



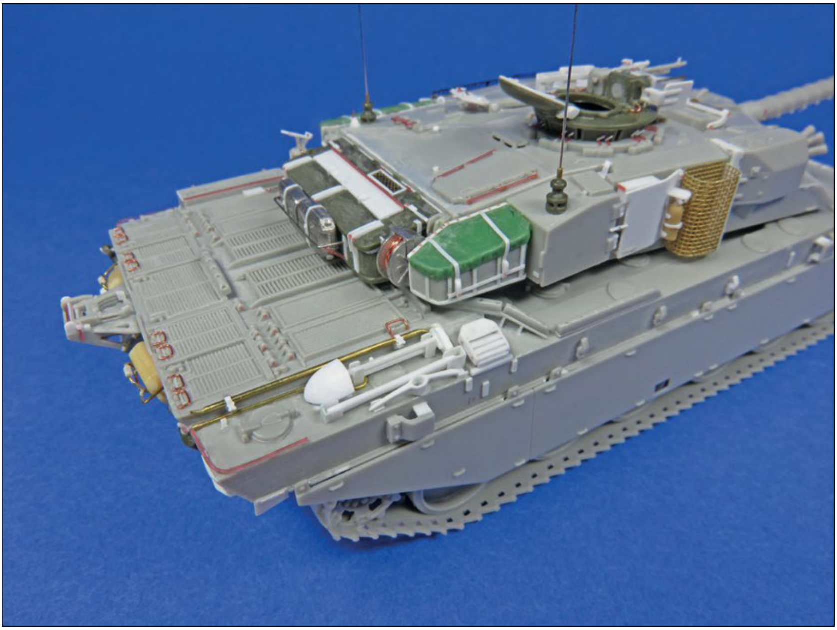
Using the large Revell rear bin I removed the top detail to allow the scribing of the double cross strengthening before replacing the hinges and other detail. The water can holder on the rear of the bin was formed *from thin brass rod.*



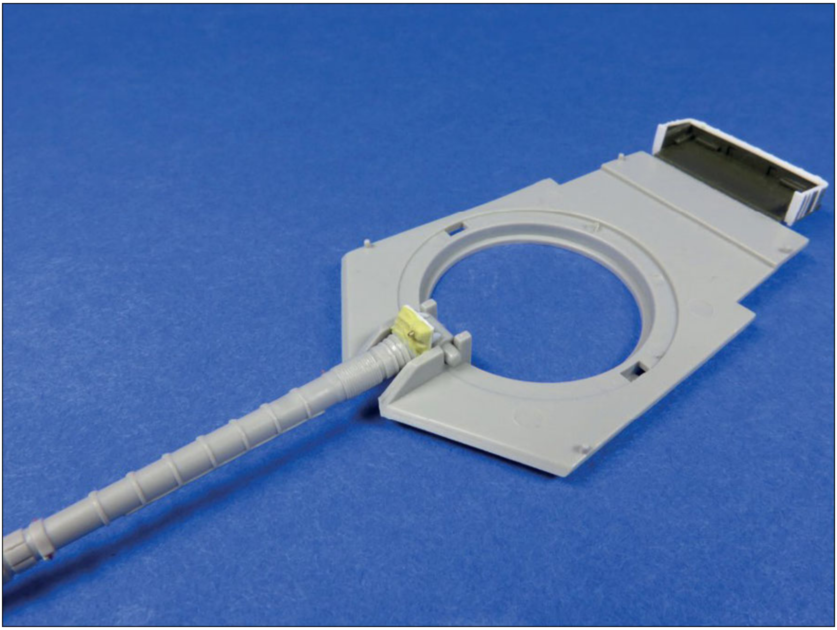
All the moulded-in-position track and pioneer tools, exhausts, light fittings, fire extinguishers and rear fuel filler guard were removed. Here the tools are shown fitted into their brackets before painting. The moulded-on engine deck handles have been carefully removed and replaced with handles bent from copper wire.



The rear hull detail showing the dark green components from the Revell kit and the black plastic card box for the driver.



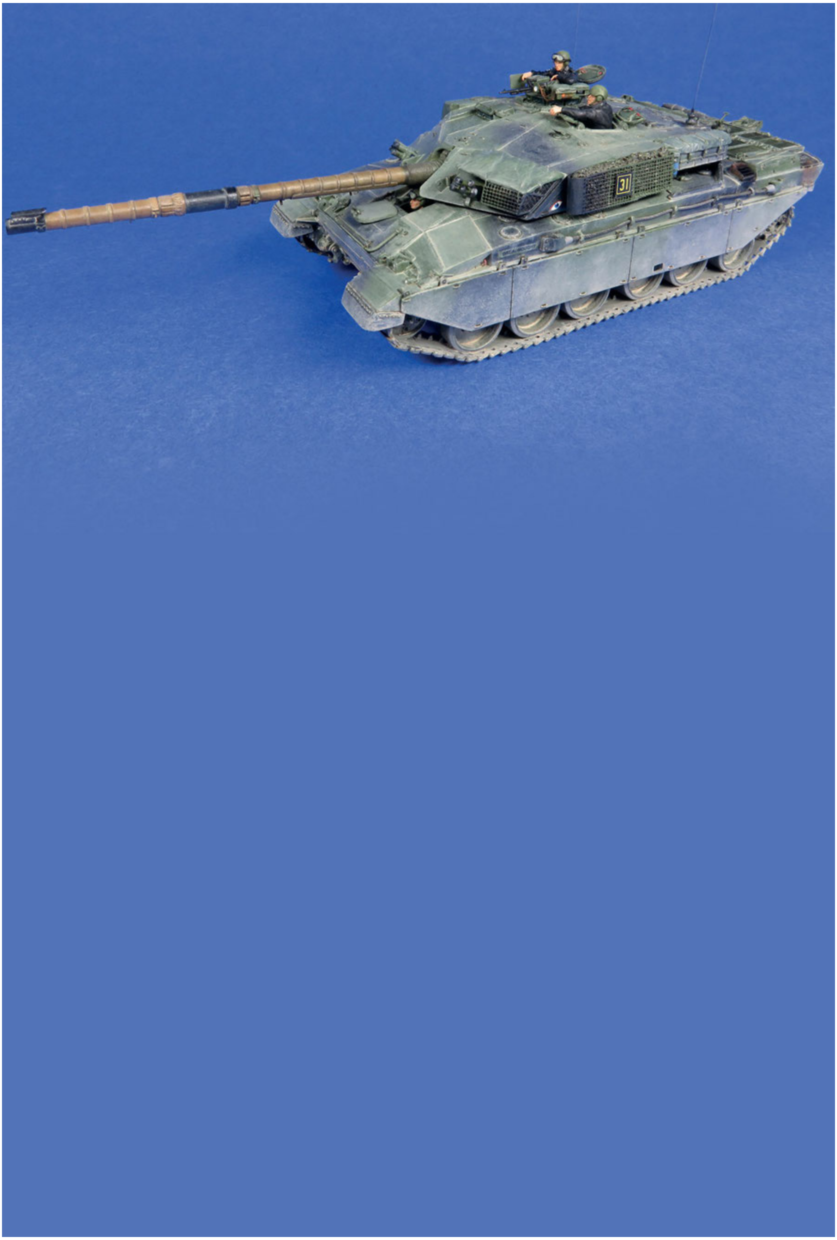
The small bin has a Duro sculpted cover and the better proportioned Revell antennae mounts have been used with thin metal rods. The water cans, Jerry cans and cable drum came from the old CMSC range of accessories.



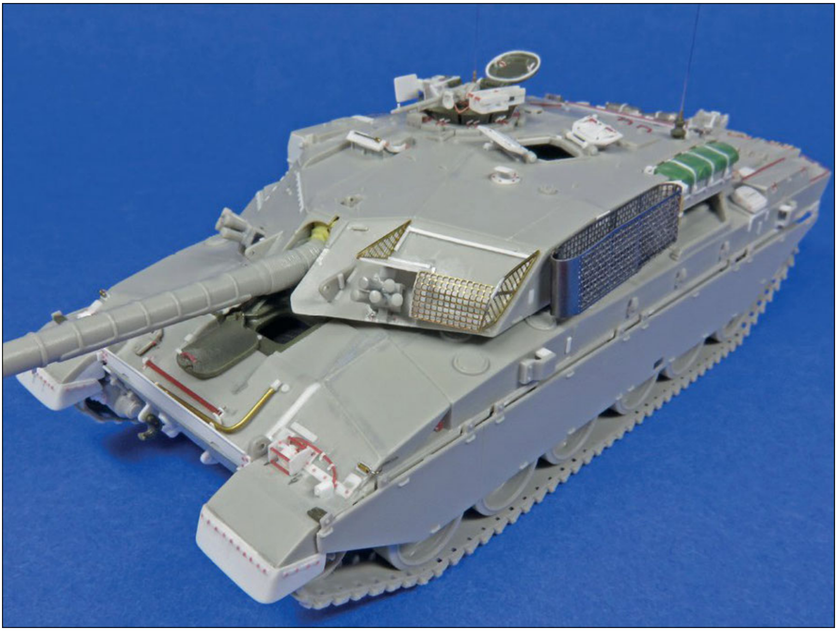
The corrected main gun fixed in to the turret base with Milliput used to create the fabric cover around co-axial machine gun and main gun. Before the Milliput set, I put the two halves of the turret together to check that the Milliput did not foul the fit of the turret.

One of the glaring errors on the Trumpeter kit is the gun barrel. Somehow, they have managed to mould the thermal sleeve on the main gun upside down.

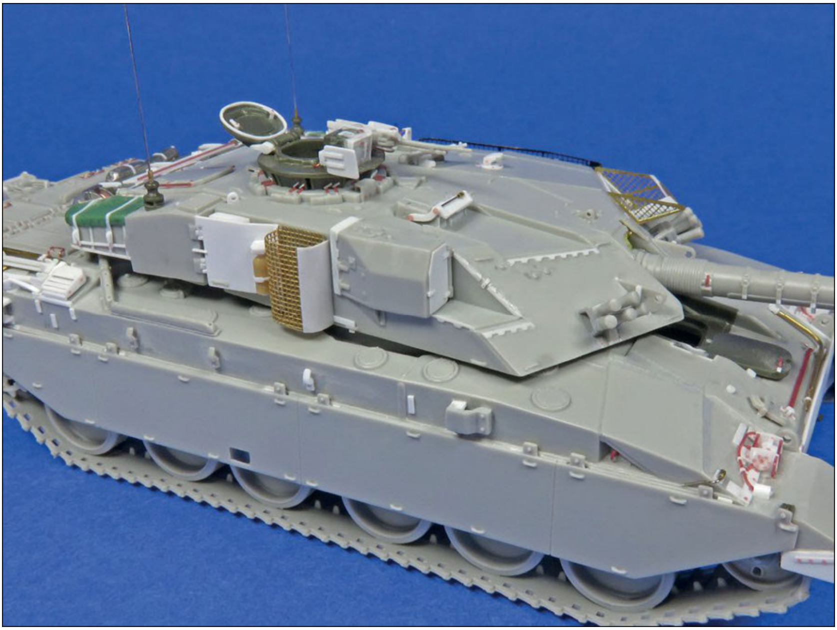
To correct this, the muzzle has to be carefully cut off and rotated through 180 degrees and reattached. The pattern of the thermal sleeve and the corrected position of the muzzle reference sight can be seen here; on the buckle side of the sleeve plastic strips were added as loose strapping.



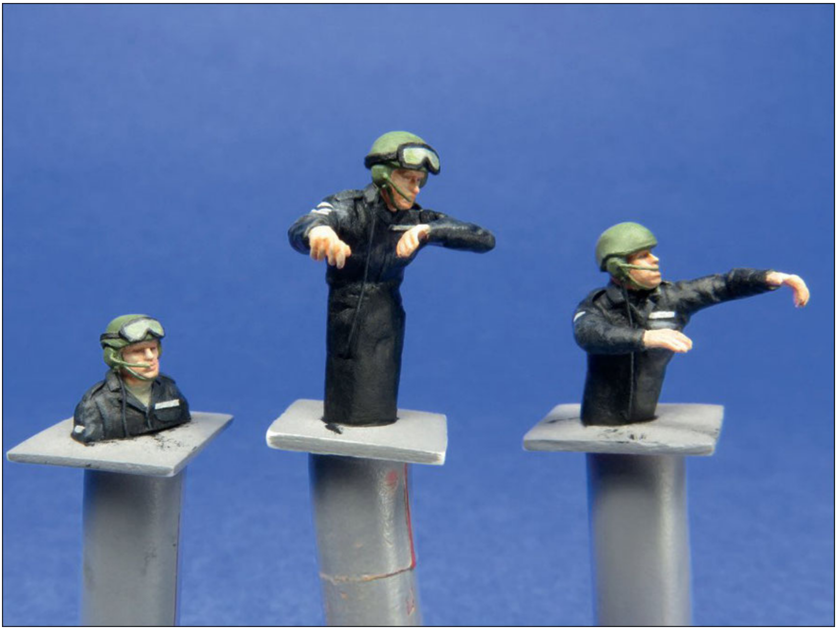
The decals for the 'Chinese Eyes' came from the BW models transfer range with the call sign board, registration number and tank name drawn on a computer and printed onto laser water slide decal paper *from Crafty Computer paper.*



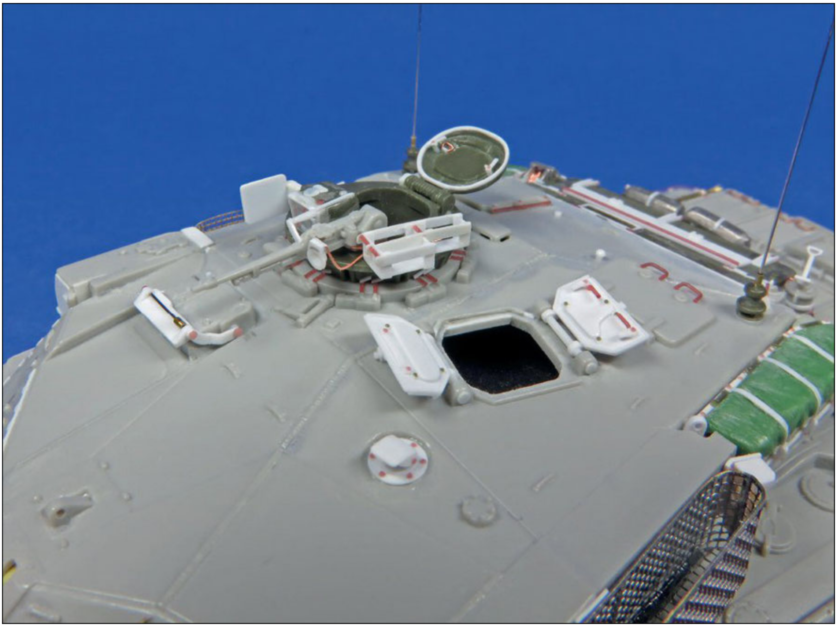
The front turret basket modified from the Extra Tech Challenger 1 metal parts basket with additional mesh and plastic card to correct the shape. The turret side has a large turret basket modified from the Eduard Challenger 1 photo-etch basket.



The new small turret basket was made from Extra Tech 0.5mm mesh sheet, with a new angled armour plate fitted in front of the TOGS compressor unit.



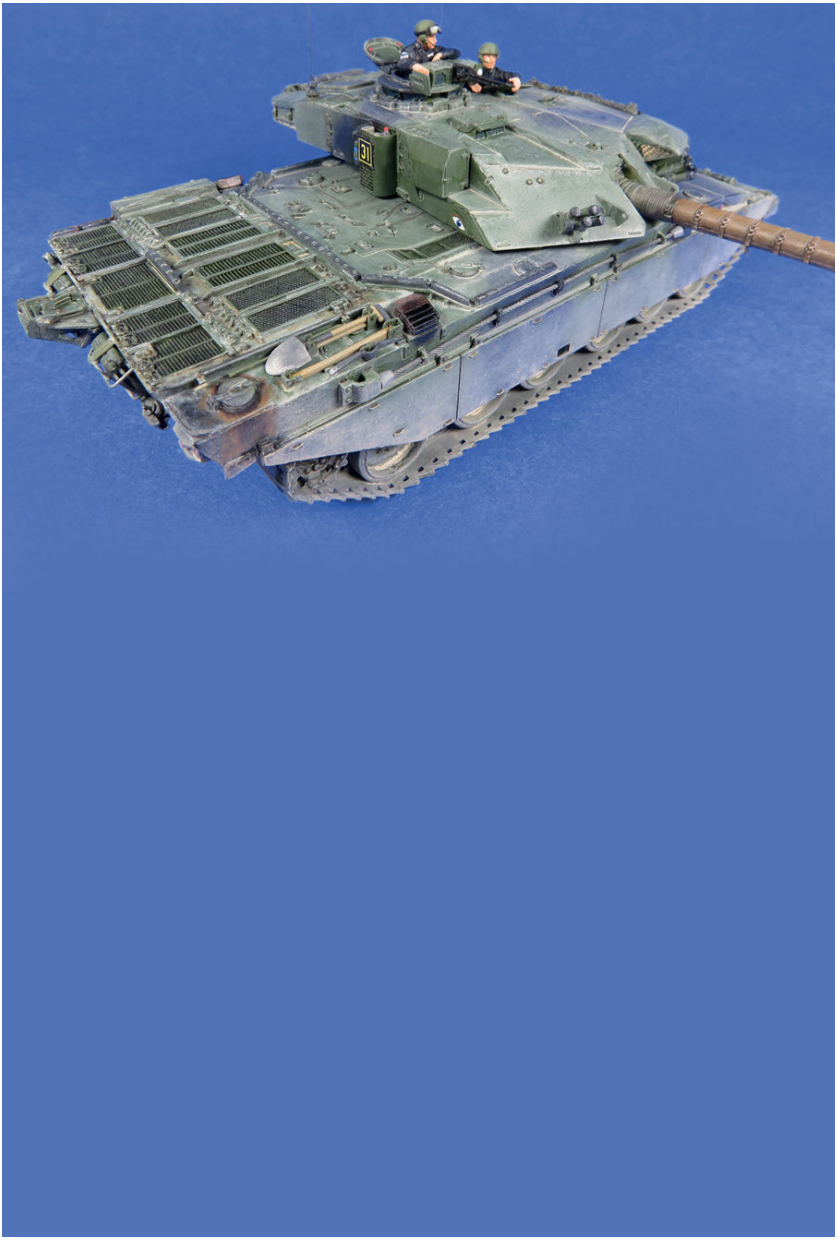
The Preiser Modern US Tank Crew and Airfix Bren gun carrier driver were converted to British tank crew with the addition of headsets and goggles. The figures were painted with Humbrol enamels as Royal Tank Regiment soldiers displaying their tank insignia and rank.



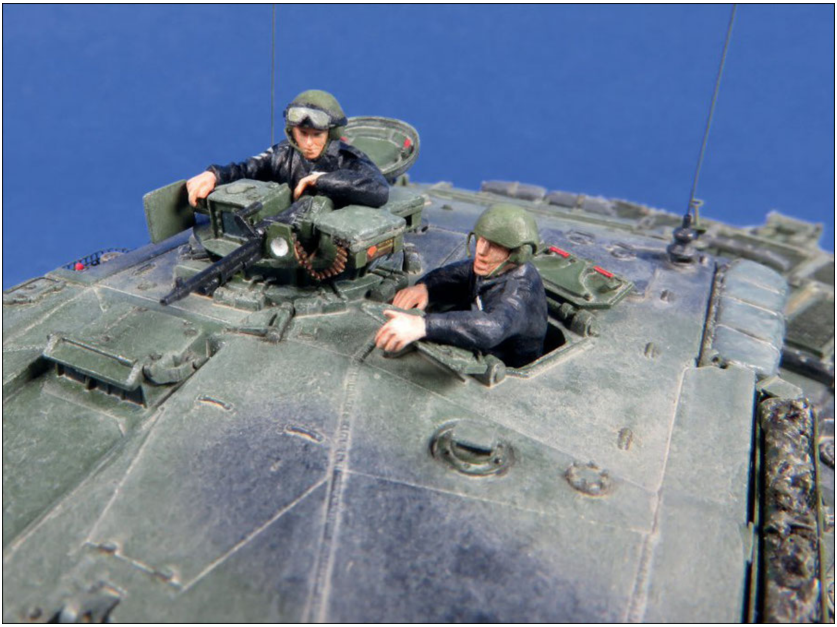
The Revell commander's cupola is combined with the Trumpeter GPMG and new ammunition box holders. The loaders hatch opening was cutout slightly smaller than the scratch-built doors to allow the doors to seal correctly when closed.

New engine exhausts and light units were built from plastic with mirror stalks from metal rod. The edges of the bazooka plates were thinned and camouflage loops were defined with a scalpel. Karaya tow cables replaced the kit parts, but the cable ends and securing brackets were retained.

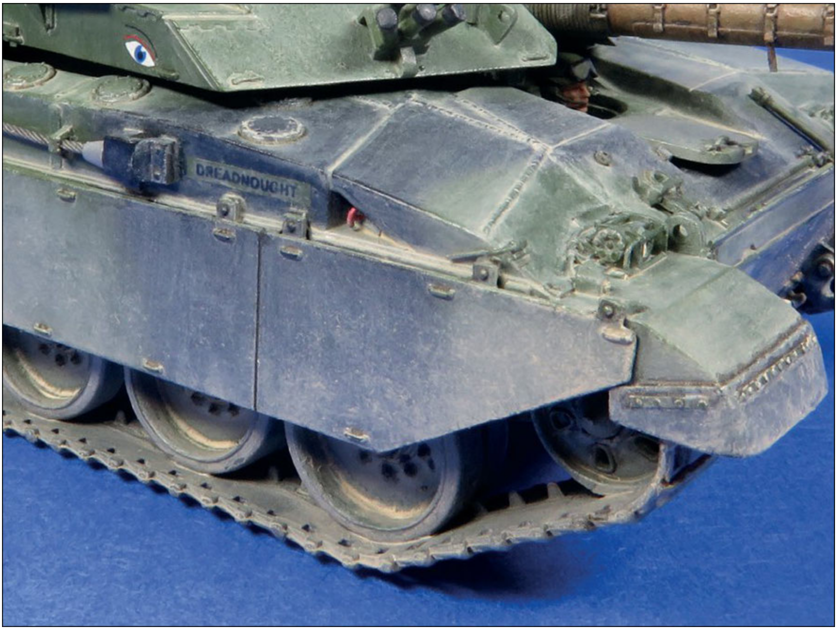
The maintenance and pioneer tools with their stowage brackets were made from plastic and metal rod.



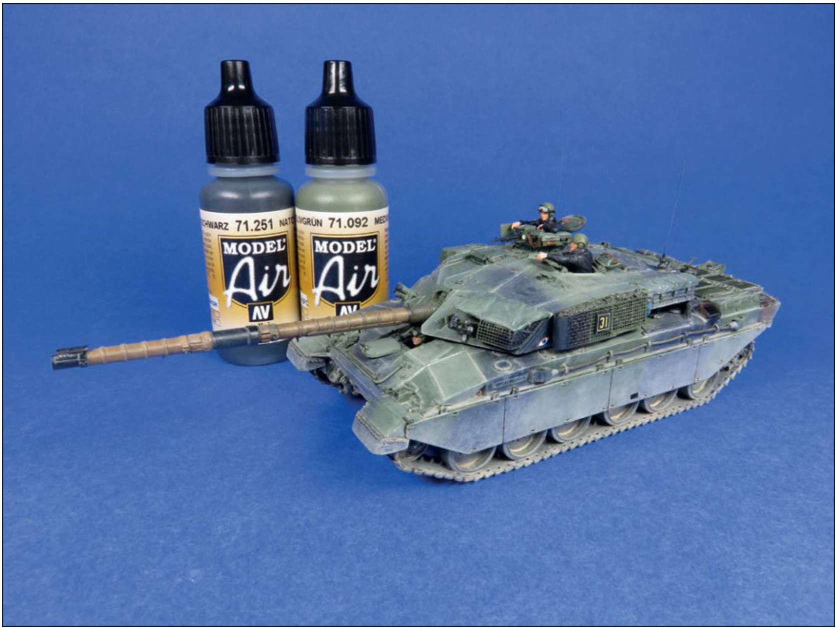
The track units were weathered with a wash of 60% Humbrol No 72 and a 40% white which was diluted with about 90% white spirit to 10% paint. The track pads were painted and when dry a dark brown wash is *applied over the tracks.*



Doors were made for the open commanders' and gunners' sights and optics detailed with wiper blades.



Once these were dry, the track units were fitted to the lower hull and the two halves of the hull were finally joined together.


SCHWARZ 71.251 NATO
MODEL Air
AV
OLIVGRÜN 71.092 MED
MODEL Air
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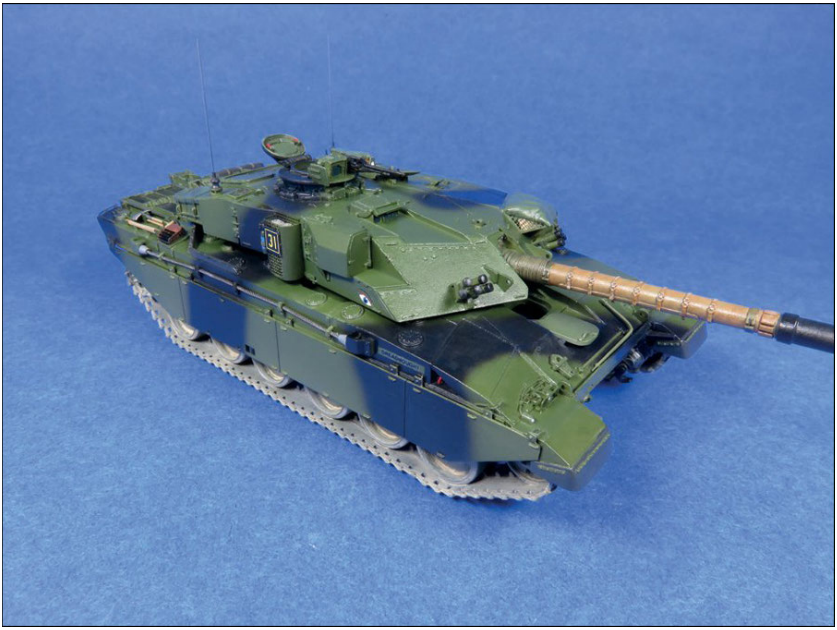
The model was finished with a base coat of Vallejo Model Air Medium Olive 71.092 and oversprayed in a disruptive pattern with Vallejo Model Air NATO Black 71.251.



With a coat of Johnsons Klear the acrylic base is protected from the white spirit washes in the weathering process. Note that the track units are already weathered.

ACADEMY

Academy released a remote-control British MBT Challenger in 1/48 scale in 2005. This kit traces its origin to the Japanese Plastic Model company Arii. At the time of writing this kit had been out of production for some time but models can still be purchased on eBay. This is essentially a snap-together kit featuring a pre-assembled transmission and remote-control device. The track is rubber-band style and the only real work involved in putting this together is when you get to the road wheels. This is not a kit for the advanced modeller. Academy have omitted to follow through the detail on parts that they consider ‘out of sight’, such as the undersides of the turret and gun barrel. However, for beginners, kids and wargaming this kit is good enough. It is cheap, it fits together easily and the size compares favourably to other 1/48 armoured vehicles.

CHALLENGER-1 BRITISH
1/48 REMOTE CONTROL TANK
WORLD FAMOUS REMOTE CONTROL TANK SERIES. 1/48 AUTHENTIC SCALE PLASTIC MODEL KIT. SET IN MABUCHI FA-130 MOTOR. REQUIRES 2 UM3 BATTERIES (NOT INCLUDED)
REMOTE CONTROL BOX
リモコン
モーター付
34KA21
70
ARII
PLASTIC MODEL
イギリス陸軍戦車 チャレンジャー1
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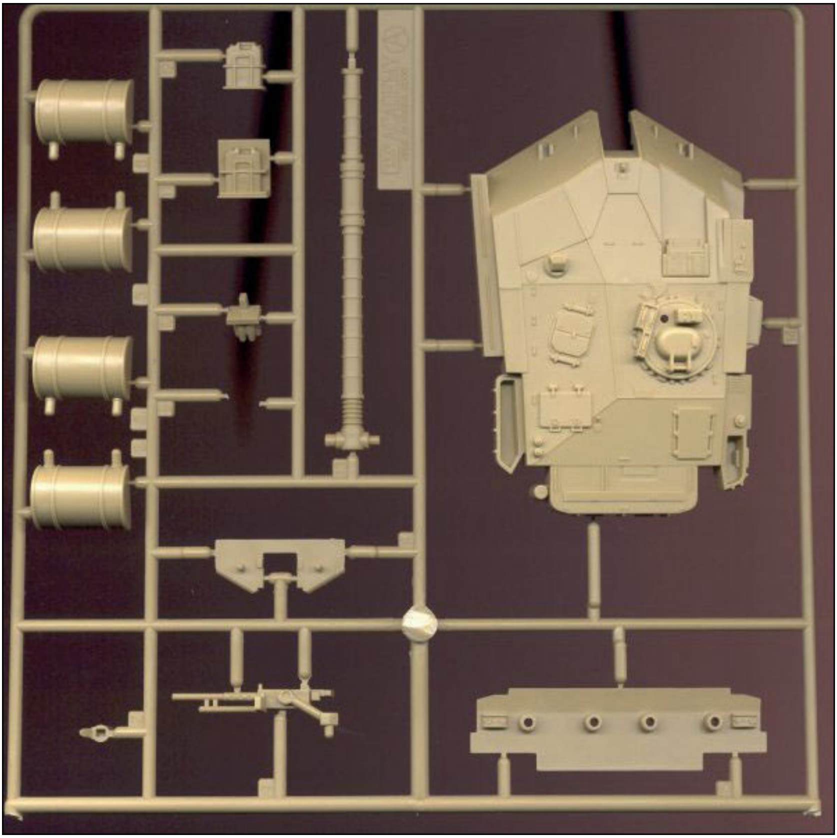
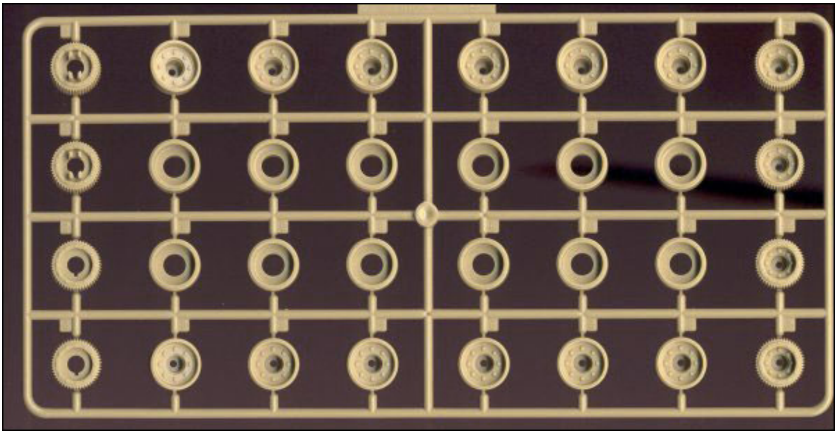
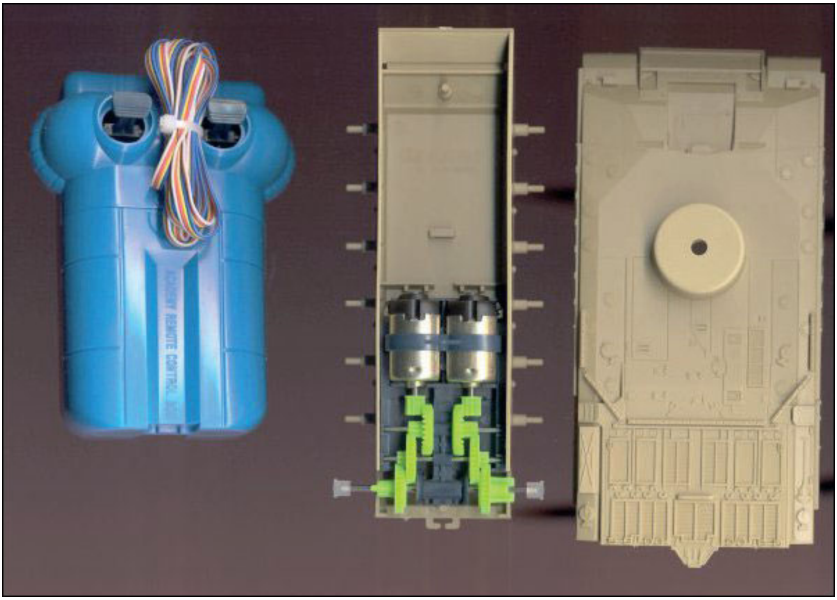


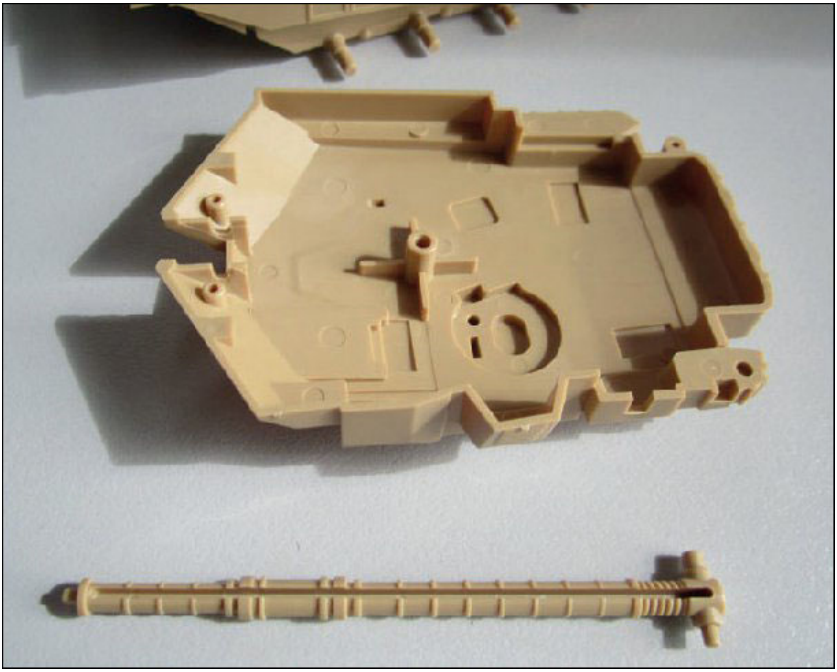


Molded in desert tan plastic, the Challenger kit is still an exercise in *simplicity. Most of the work is in assembling the road wheels. (Courtesy Michael Benolkin www.cybermodeler.com)*



The unit is powered by a pair of electric motors that are snapped into the transmission frame. Power is supplied from a pair of batteries located in the handheld controller and power/control is via cable that runs between the tank and the controller. The wire leads will have to be attached to the two motors in the hull, and while a simple 'strip and twist' will work, soldering the leads into place is recommended.

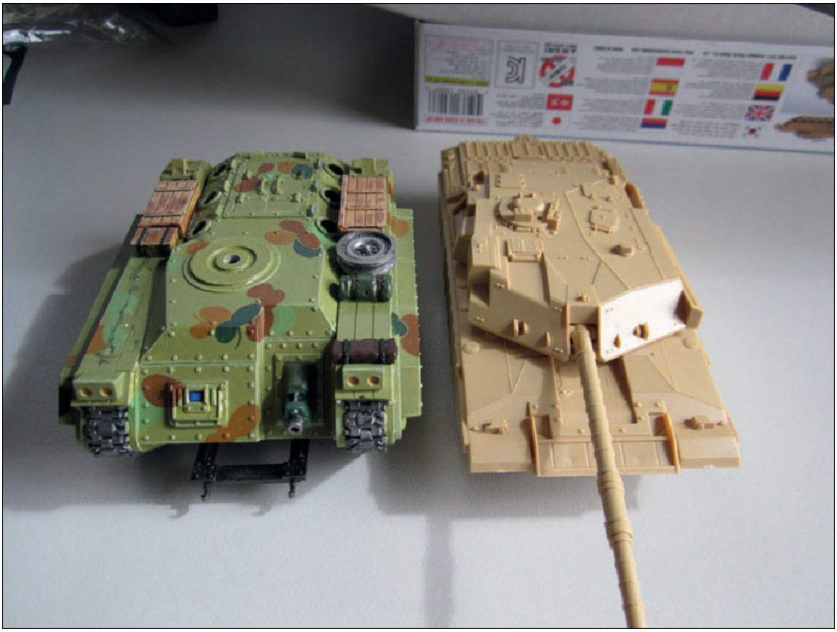
(Courtesy Michael Benolkin www.cybermodeler.com)



Out of sight, out of mind. Moulding detail has not been followed through on the inside of the turret or the underside of the gun barrel on the static kit. (Courtesy azazel.com)

BRITISH MAIN BATTLE TANK
CHALLENGER
1/48TH SCALE STATIC MINI TANK SERIES NO.3
World famous main battle tank series
Ready to quickly & easily assemble plastic model kit(no glue required)
Highly detailed hull, turret & various parts
ACADEMY
HOBBY MODEL KITS
STATIC MINI
3
TANK SERIES
Δ40

Academy PKAY13007 is a static 1/48 scale kit.



The static kit has good detail and is recommended for wargamers. Here it is pictured next to a Chimera for size and height comparison. The Challenger would be a bit taller as the wheels and tracks have yet to be assembled.

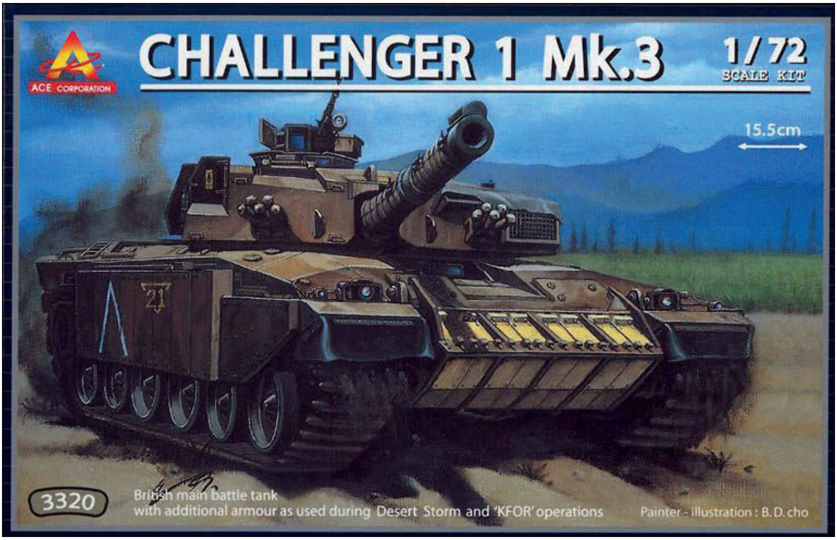
Kit component pictures reveal the hull and chassis in separate bags and rubbery plastic tracks, not uncommon for tracked vehicle model kits.

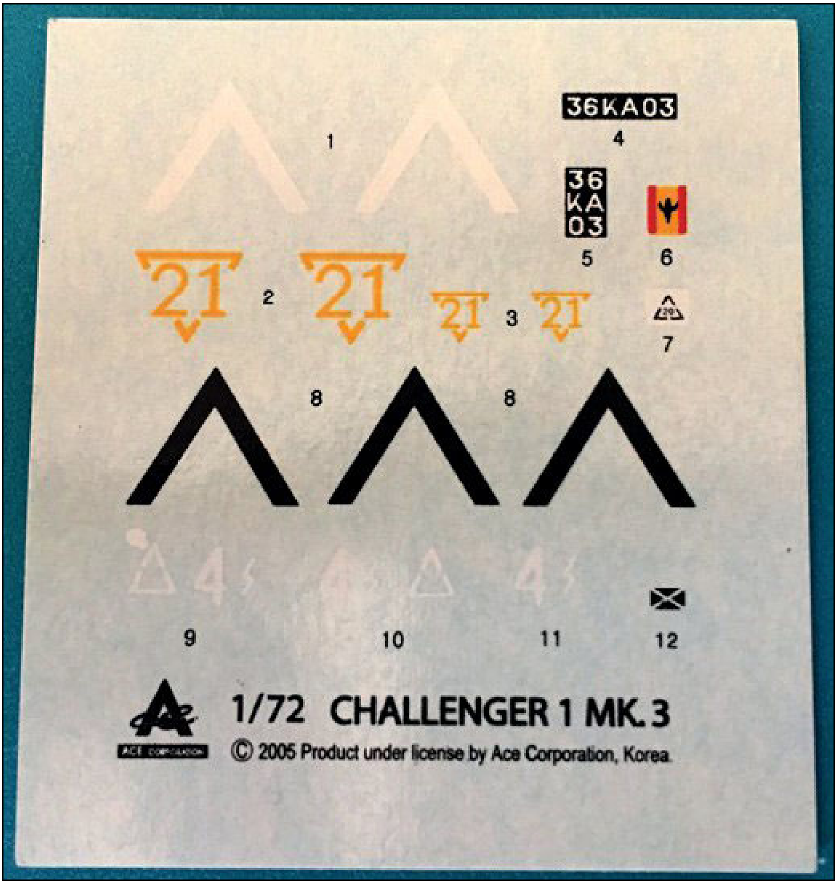
Looking at this kit as something to use/ convert for miniatures wargaming, it will do the job admirably and at a very reasonable price. For this the Academy line as worth checking out. (Courtesy azazelx.com)

ACE CORPORATION

This Challenger 1 Mk 3 1/72 scale is moulded by Revell and was released by ACE Corporation (South Korea) in 2005 with changed decals, although only one decal option is available, whereas Revell has three. The kit doesn't have any fit problems, there are lots of sharp moulded parts and the well-detailed link and length tracks work in this scale. Welds are included on the hull and turret, there is sharp bolt detail on the road wheels and a nice twist to the tow cables although these look to be a little too thick. The one-piece gun barrel has very nice thermal sleeve moulding too. With additional stowage bins and some crew figures this could make quite a showpiece.

Images courtesy of Arhan Atalay, miniafv.blogspot.com


ACE CORPORATION
CHALLENGER 1 Mk.3
1/72
SCALE KIT
15.5cm
3320
British main battle tank
with additional armour as used during Desert Storm and 'KFOR' operations
Painter - illustration : B.D.cho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36 KA 03
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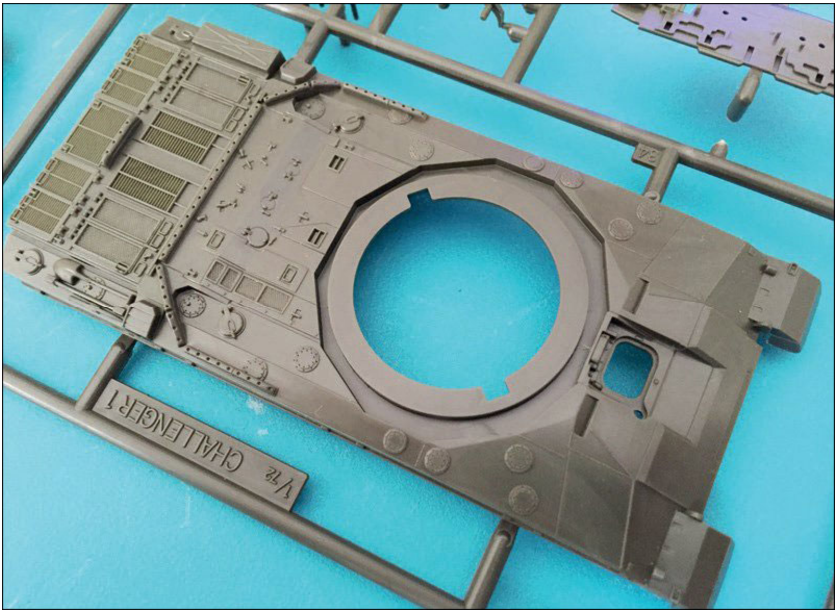
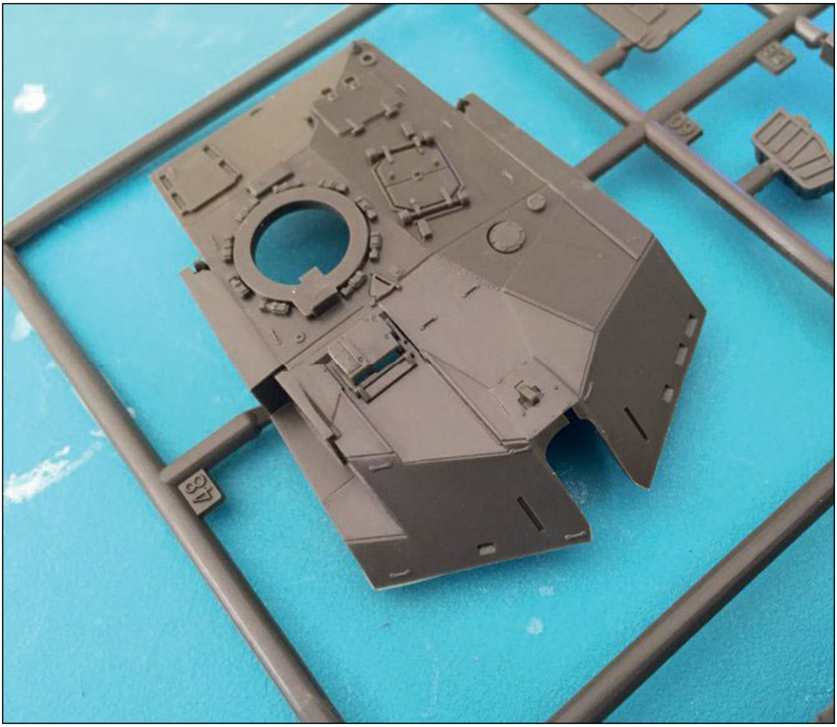
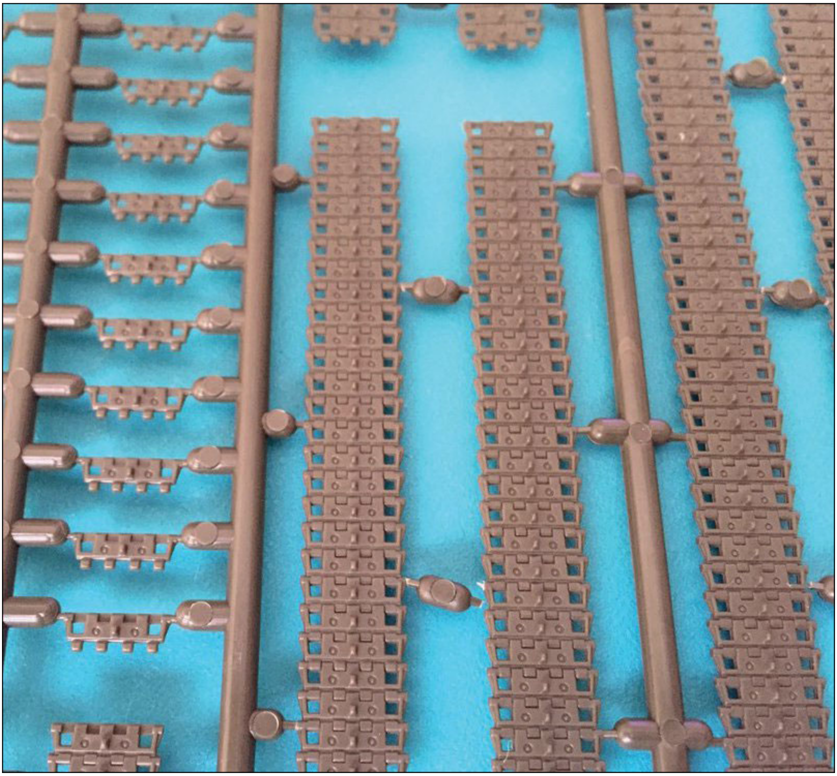
1/72 CHALLENGER 1 MK.3
ACE CORPORATION
© 2005 Product under license by Ace Corporation, Korea.

A lot of detailed moulded parts are present on the hull and turret. This kit offers a single decal option: Kosovo KFOR.


1/72 CHALLENGER 1





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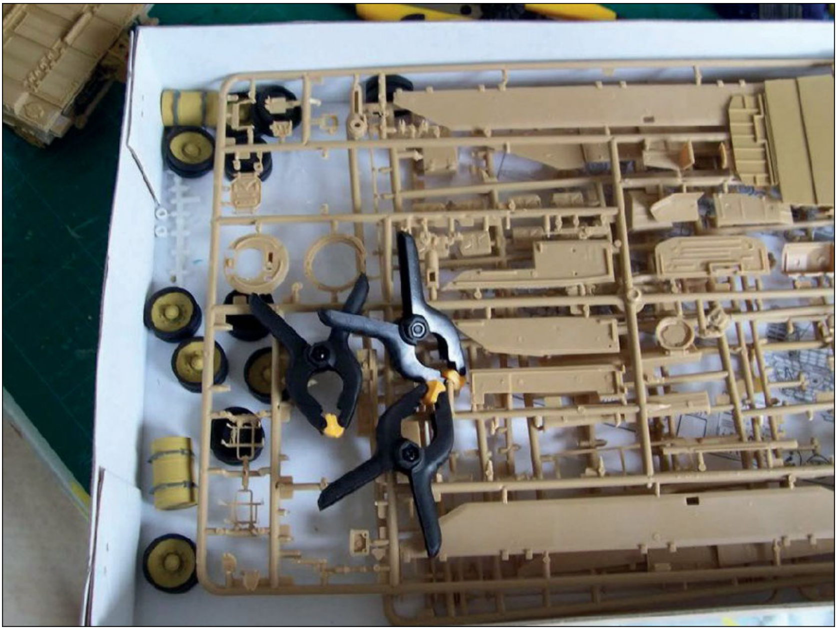
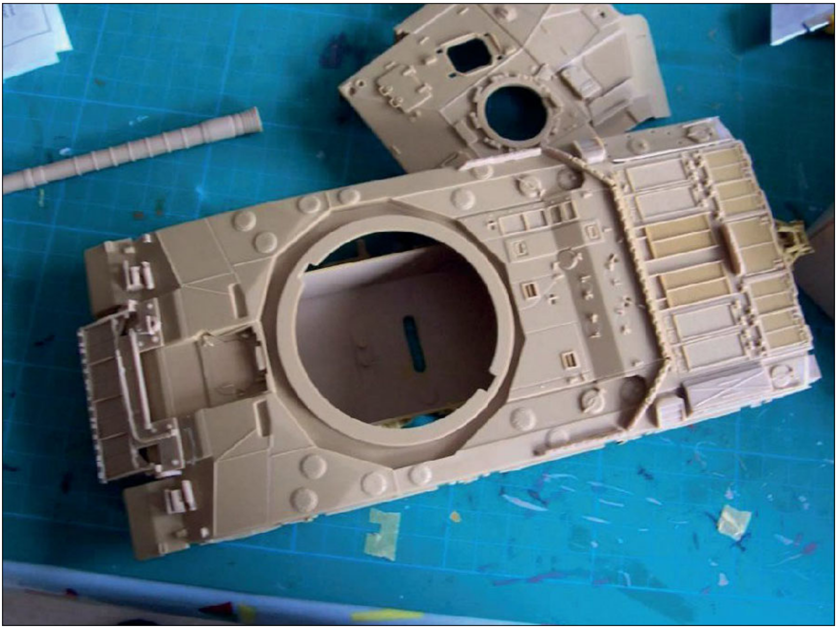
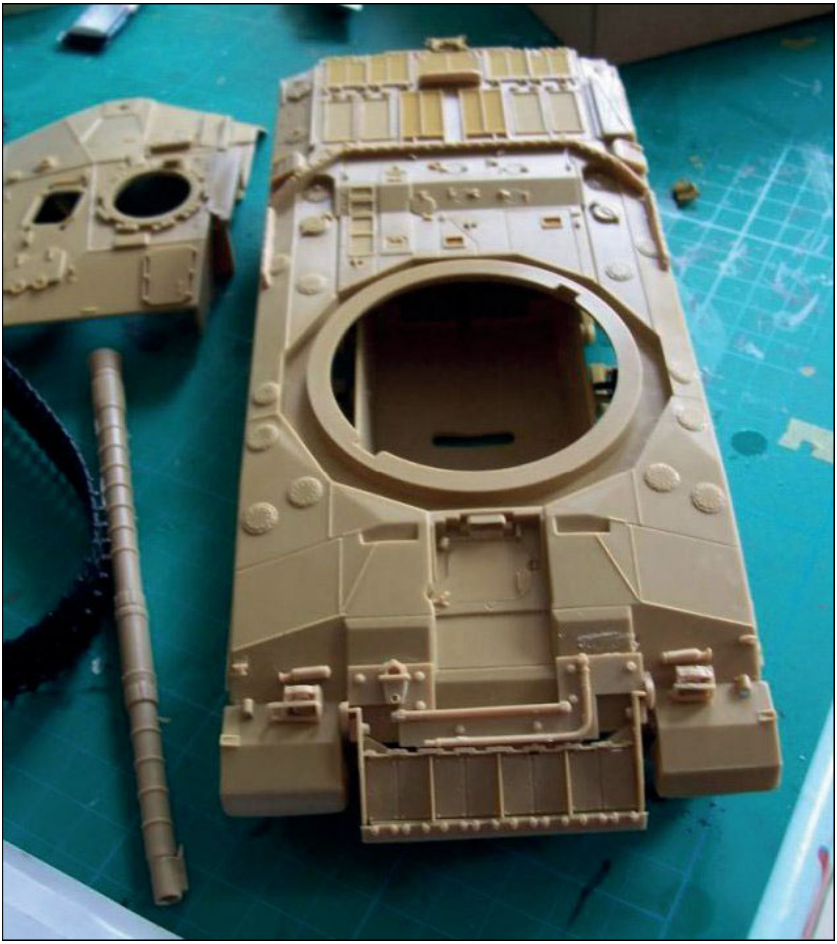
CC LEE/MODELCRAFT

CC Lee, a Chinese plastic kit manufacturer, released a Challenger 1 Mk 3 1/35 scale in the 1990s. It was re-boxed after the millennium as a Modelcraft kit. Feedback on this kit is unambiguous, most modellers who have attempted it, or other CC Lee kits, have labelled it a cheap knock-off of the Tamiya kit: the instructions are photocopies of the Tamiya instructions. While some modellers have advised 'walk away', others have said it's a great opportunity to practise one's painting and weathering.

Images courtesy of Mark M www.britmodeller.com







CHALLENGER 1 (Mk.3)

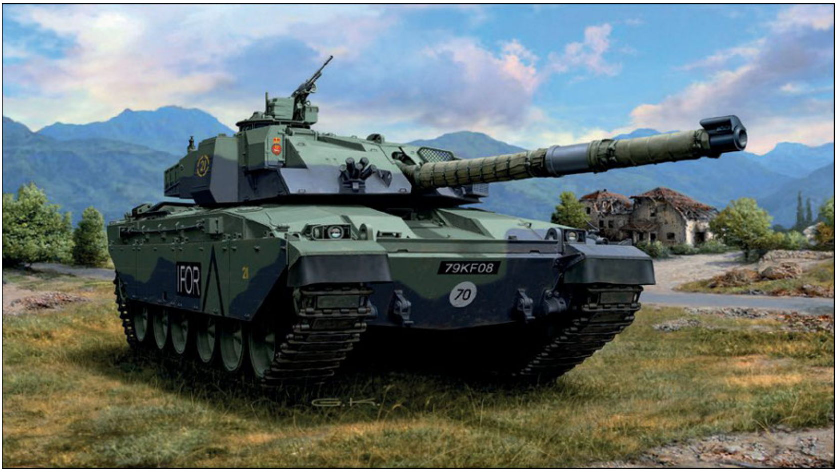
No. 00304

The instructions are photocopies of the Tamiya kit instructions and the kit itself is a knockoff of the Tamiya kit, unfortunately without the Tamiya attention to detail.

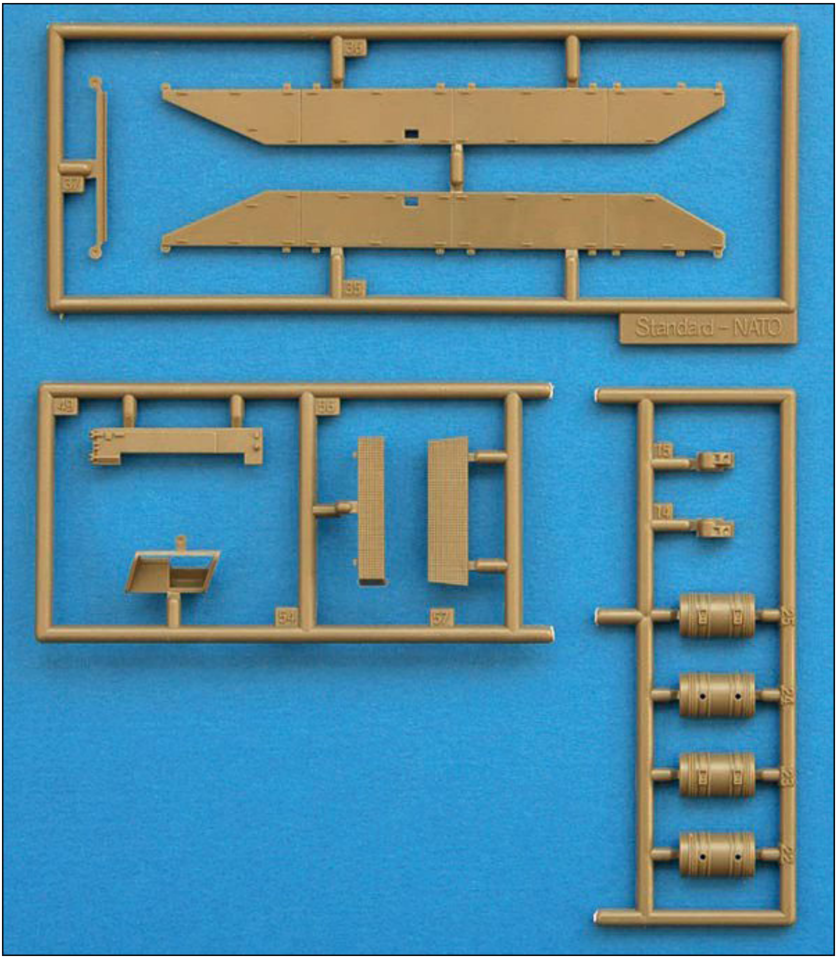
REVELL

In the late 1980s Matchbox released a Challenger 1 tooling, it came with two decal options: BAOR Royal Tank Hussars 1986 and BAOR 2nd Royal Tank Regiment 1987. In 1990 Revell bought the entire range of kits with a ten-year licence to use the Matchbox brand, and re-boxed the 1/76 scale Challenger 1 in 1994. Thereafter a number of Matchbox kits were released under the Revell brand including this kit which was re-issued unchanged except for the box art and instructions. The 1/72 scale Challenger 1 was out of production at the time of writing but still fairly widely available. It is an original Revell tooling and is beautifully moulded: grilles, handles, hatches and weld seams, as well as the detail on the 120mm gun barrel and commander's GPMG are intricate and quite outstanding for a model in this scale. Two decal options are included: BAOR 17/21 Lancers 1986 and NATO IFOR Bosnia-Herzegovina Queen's Royal Hussars 1996. The kit includes some nice extra detail like rear external fuel tanks and the tracks are injectionmoulded link and length tracks with individual links to go around the drive and idler wheels. The pioneer tools are well moulded on, although it would have been nice if they had been moulded separately and the wire baskets would be more realistic with mesh but the Revell baskets will do for most modellers. Due to the large number of parts (129) in this scale, it is not a beginner's kit: Revell has it pegged at level three. In all this is a wonderful kit in this scale, but make sure the road wheels are parallel to the hull otherwise they'll be at an angle. A highly recommended kit.

Images courtesy of Revell and Paul A H www.britmodeller.com



Here the modeller can clearly see the level of detail on the turret, the 120mm gun and the 7.62mm GPMG found on the commander's cupola. The wire baskets are simply moulded with a textured pattern, so you may wish to replace these parts with fine mesh for added realism.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Standard - NATO
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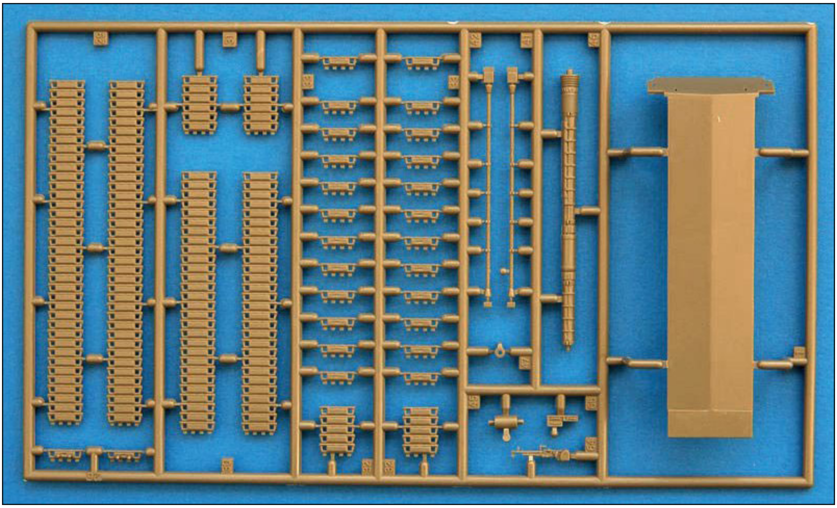
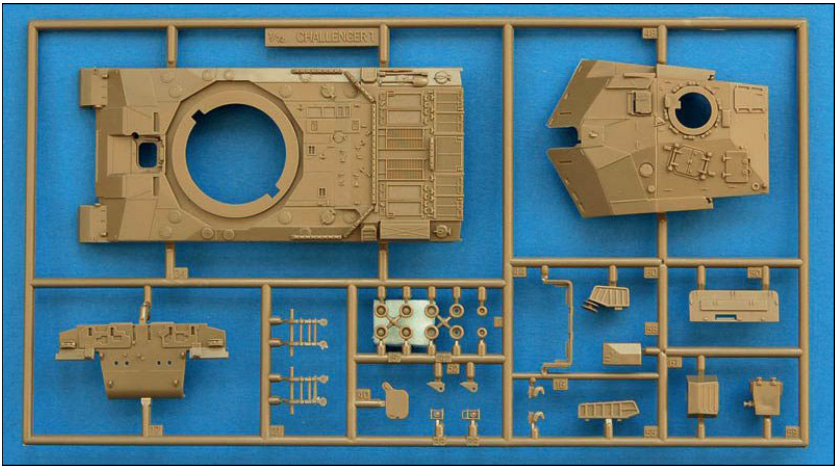
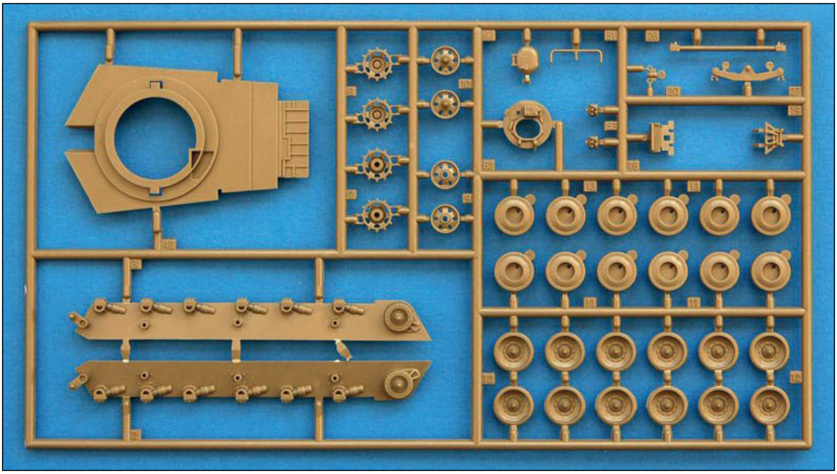


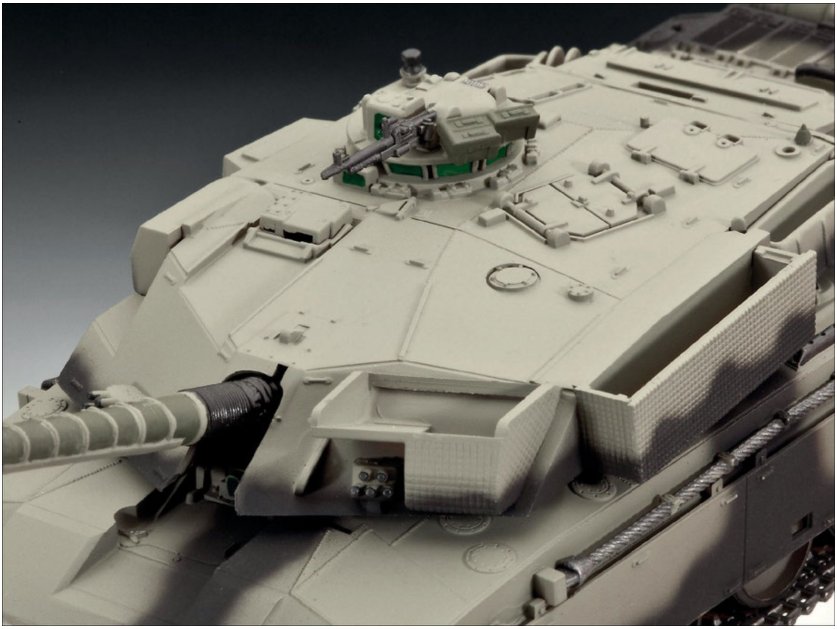
Paul A H goes on to say: ‘The driver’s turret can be posed in the open position, as can the commander’s hatch on the turret.In keeping with the rest of the kit, the distinctive flat, angular turret is beautifully detailed and includes a comprehensive range of turret bins and stowage boxes’.





Paul A H of www.britmodeller.com comments on the Revell 1/72 scale kit: 'Grilles, handles, hatches and weld seams are all beautifully depicted. There are no sink marks or flaws and no flash present anywhere.'

A detailed view of the Revell 1/72 scale Challenger 1. Much of the turret and hull detail is moulded on. The extra fuel drums are moulded separately.



Revell
LEVEL 4
1:76
100 PARTS
15,2 cm
CHALLENGER I
64K687
IIB
03308

IIB
64KG87
CHURCHILL

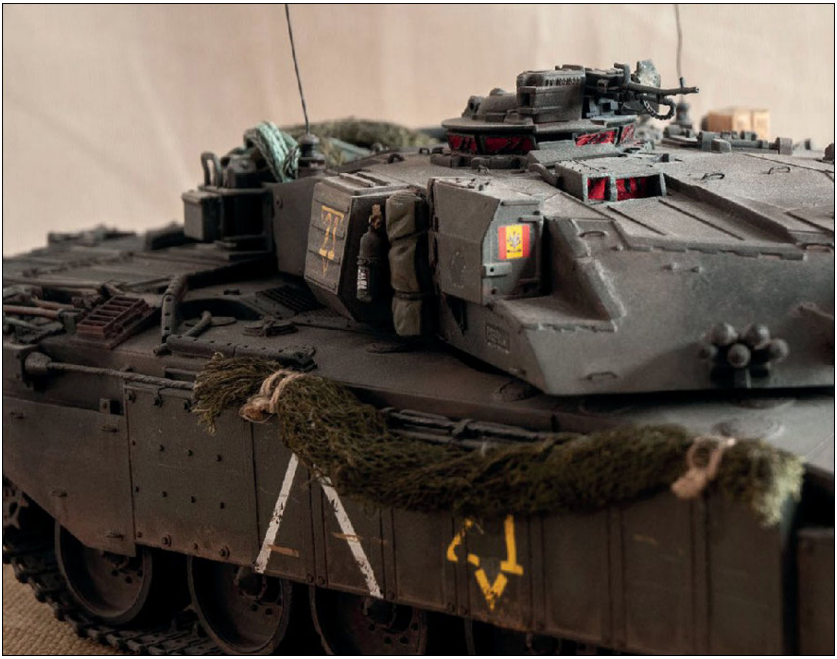
The re-boxed Matchbox 1/76 scale Challenger 1 licensed and released by Revell.

CHURCHILL
64KG87
70

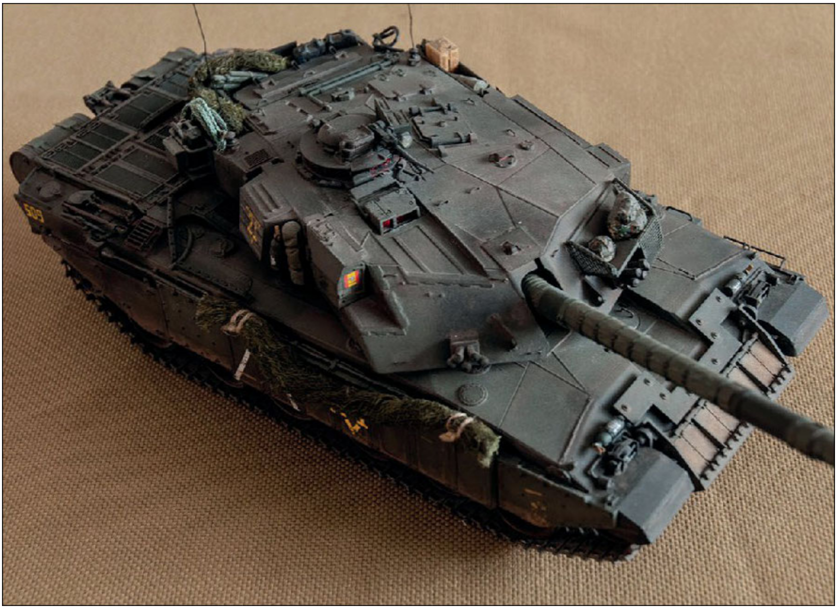
IIB
RCHILL

TAMIYA

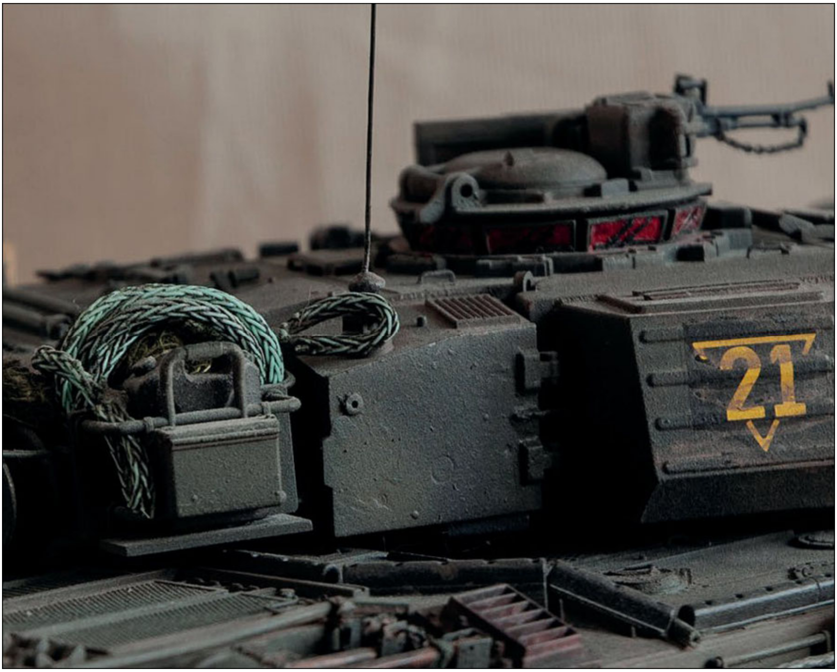
Tamiya's British Main Battle Tank Challenger in 1/35 scale was first released in 1986. It was updated with new parts and box art in 1992 as a Challenger 1 Mk 3. There are three decal options for the BAOR in dark olive green and one for the UK Mainland Division in dark olive green and flat black. The Mk 3 is available as an unknown unit from Operation Granby in the Gulf War as well as a NATO unit. The Neil Whiteley-Bolton raised glacis present on all prototypes, early marks and Shir prototypes was removed in the mid-1980s on most but not all service tanks. To correct the Tamiya model the inside glacis would need to be removed and do not build up the track guards as many do. This kit requires a little clean-up where the halves of the main barrel join and while it isn't the flash Dragon, Trumpeter or Meng kits now available, it is still vintage Tamiya: a reliable, well-detailed kit that builds up fast. The kit includes the commander figure, mesh for the stowage bins and plastic tracks.



From this angle, the all-important details of the lashing loops, periscope glazing anti-glare film and strengthening strips can be seen. Of note is the upcycled Ferret armoured car stowage bin in front of the cooling *pack housing, KRH Colours on the TOGS barbette door and scratched Chobham side armour revealing its desert colour scheme. (Ben Skipper)*



Here you can really see the extent to which crews increased the Challenger's poor stowage options. Note the Chieftain and Scorpion bins attached the port side of the turret and an extra bustle welded to the rear of the 'Coffin'. Also seen is the additional Toe Cap armour, whose addition meant the track torsion socket and rod set was now located to the top of the turret behind the turret battery access hatch. (Ben Skipper)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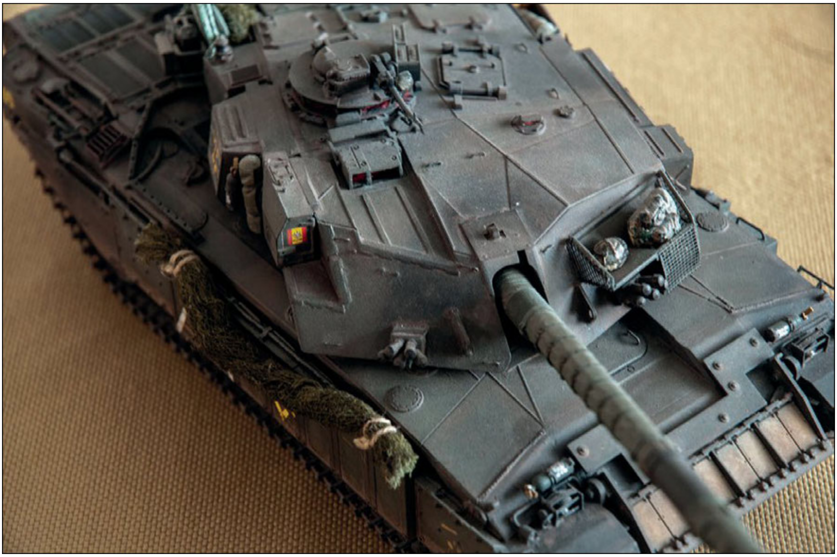

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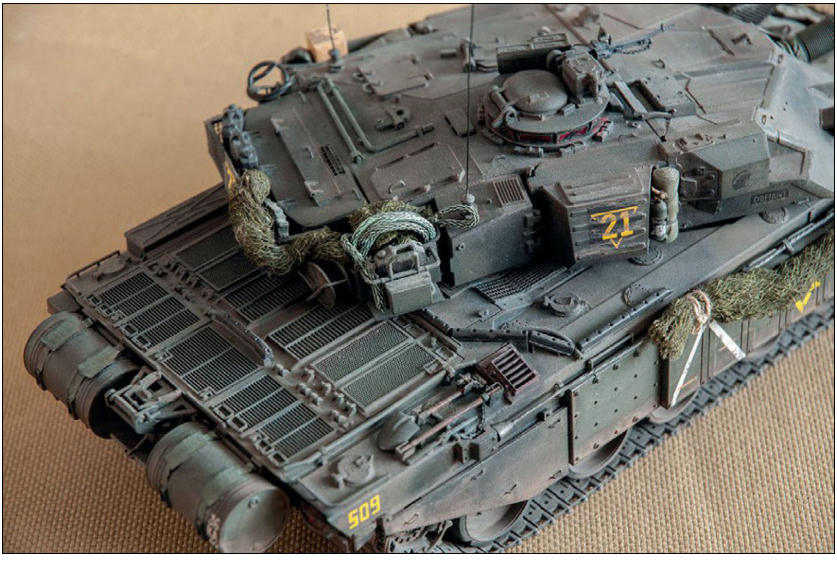
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DEFIANT
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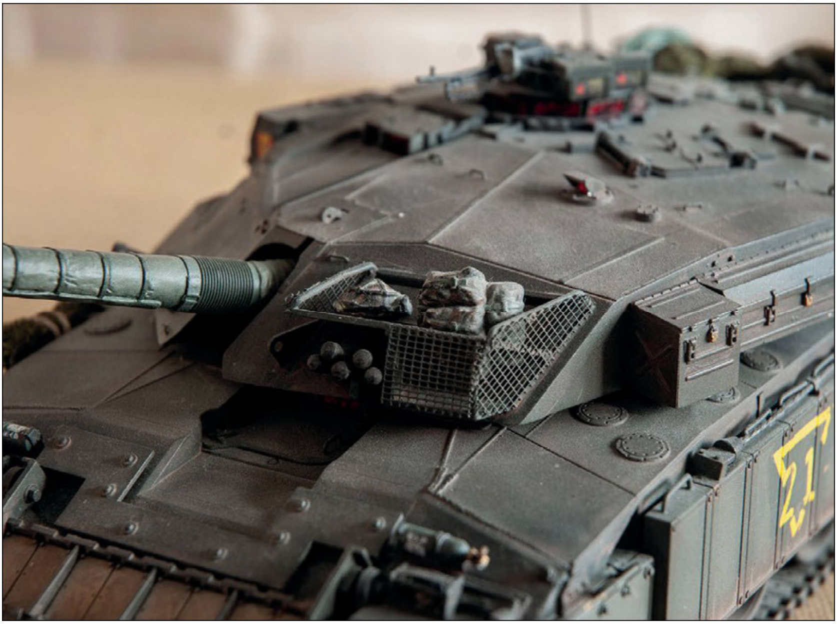
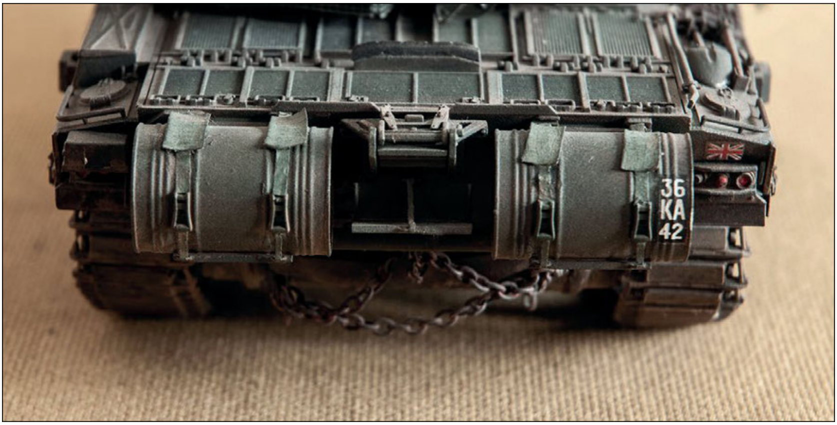




Modeller Ben Skipper comments on the kit thus: ‘This model is of the quality that has become synonymous with Tamiya. Beautifully cast, with no sink marks, it pretty much falls together. The instructions are clear and easy to follow, with kit decals being sharp and in register. The fit of the turret sides and rear plate though is not the greatest, so expect to use some filler here. Some aspects of the build can be a touch fiddly, especially shaping the front bustle nylon mesh and rear callsign plate, also beware of smaller parts that may disappear into the ether as this kit *has one or two. I used a range of aftermarket goodies to bring the 62-ton beast alive; these included the Echelon Fine Details (Decal Sheet No. T35002), Tamiya's Modern U.S. Military Equipment Set (35266), Accurate Armour fire extinguishers, Eduards PE set (Product 6137 / 6883), Calibre nuts and bolts (CAL-35048) and numerous wires and plastics from the spares box. These aftermarket items, combined with a bit of patience and some experience in modern Tamiya armour kits, really turn an otherwise reasonable model into something really very special.'*

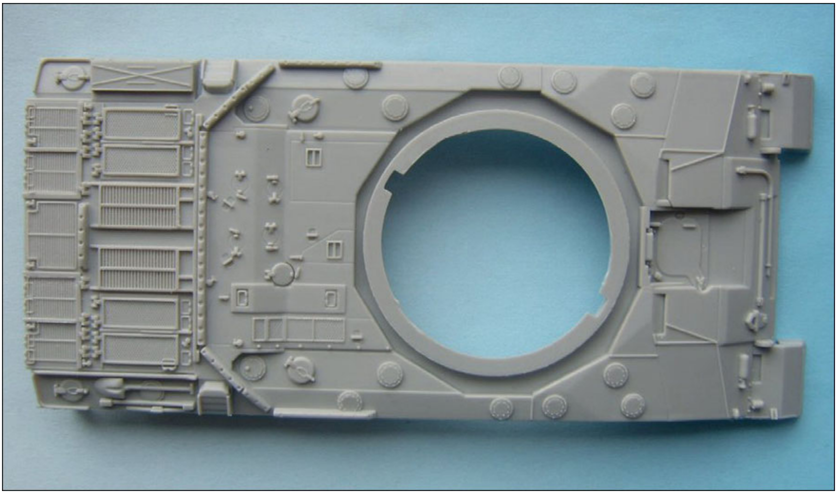
TRUMPETER

Trumpeter's Challenger 1 MBT is in 1/72 scale and is available in two versions: Desert (Royal Scots Dragoon Guards) and NATO: both are up-armoured and the latter is a new tooling. The Desert version has pros and cons. The hull top includes a lot of detail, the pioneer tools are well defined and the fire handles are not only represented, they're in the right place, but all this is moulded on, including the equipment in front of the driver which must first be removed before the bow armour can be fitted and no mention is made of this in the instructions. The turret is well moulded but the thermal sleeve for the gun barrel is the wrong way around (the mounting point and MRS are the right way, which is unfortunate as the mounting point also has a part for the coaxial GPMG that is missing from the Revell kit). The parts that are added to the turret and hull are a similar mixed bag of good and not so good but it must be said that this kit will do very well for most modellers. The more keen-eyed will take issue with certain details but will then also have the experience to overcome these drawbacks. One way to do this is to combine this kit with its Revell counterpart. Although the NATO version is a new tooling and has the same level of intricate detail, it is also moulded on. But for most, this will be a splendid build.

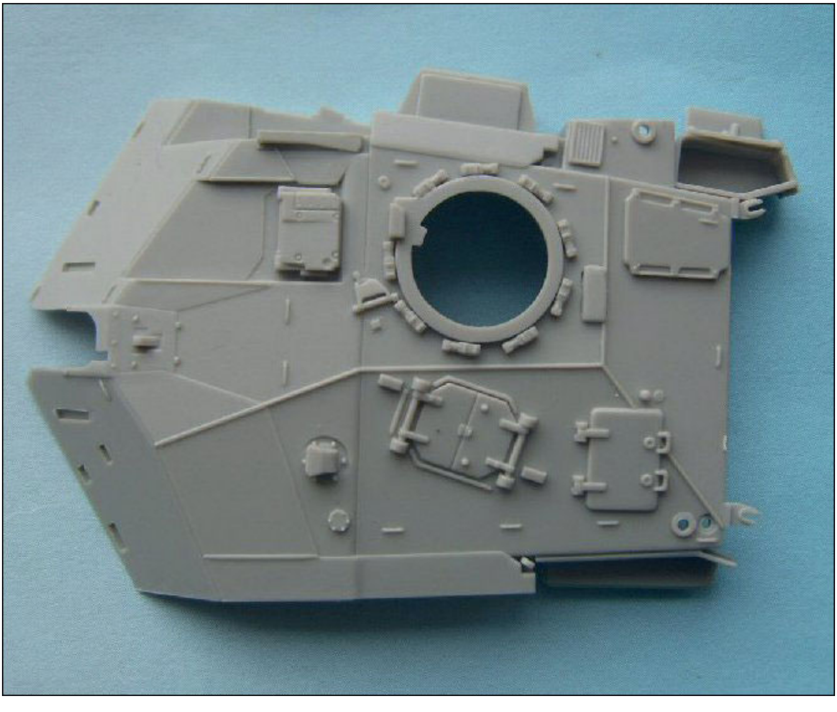
Images courtesy of Simon Barnes and Bachmann Europe

PKTM07106 Challenger 1 MBT

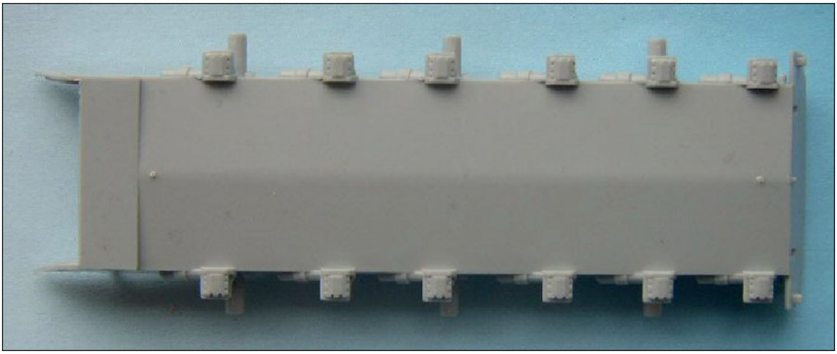
PKTM07105 Challenger 1 MBT Desert Version

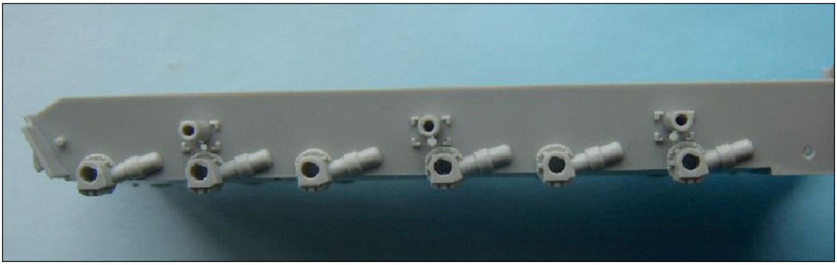


The Trumpeter hull includes a lot of detail missing from other kits such as the guards around the filler caps, clasps on the stowage bin and fire extinguishers, but they are moulded on.

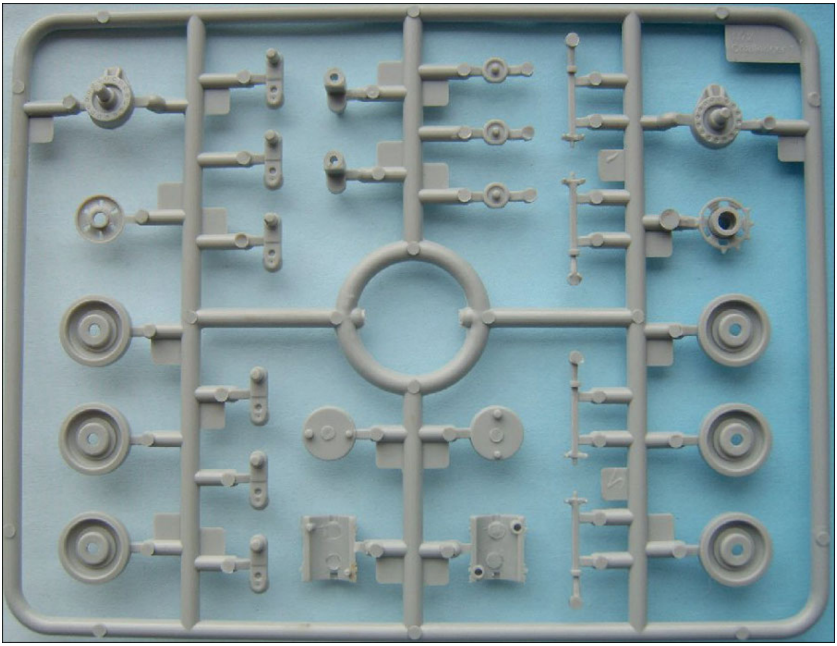


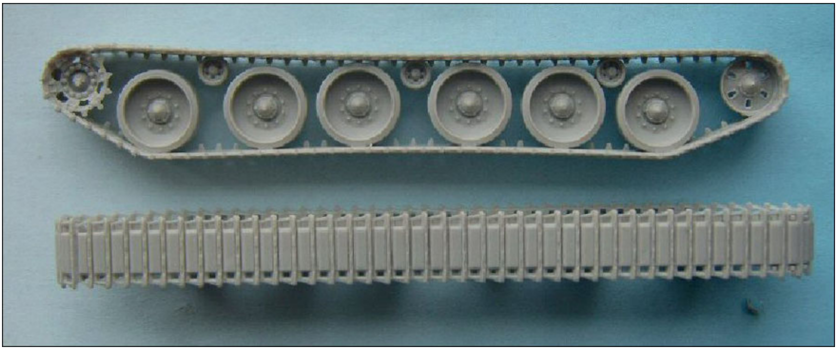
The turret has definitely benefited from slide moulding, with detail now present on the walls of the turret. The stowage bin is moulded in place. The odd thing is that the armoured door for the main sight is moulded shut. While it does do this, it is very rare to see it in this position. However, Trumpeter got the slight depression in front of the sight correct. The loader periscope, while not 100 percent, is better defined and shaped.



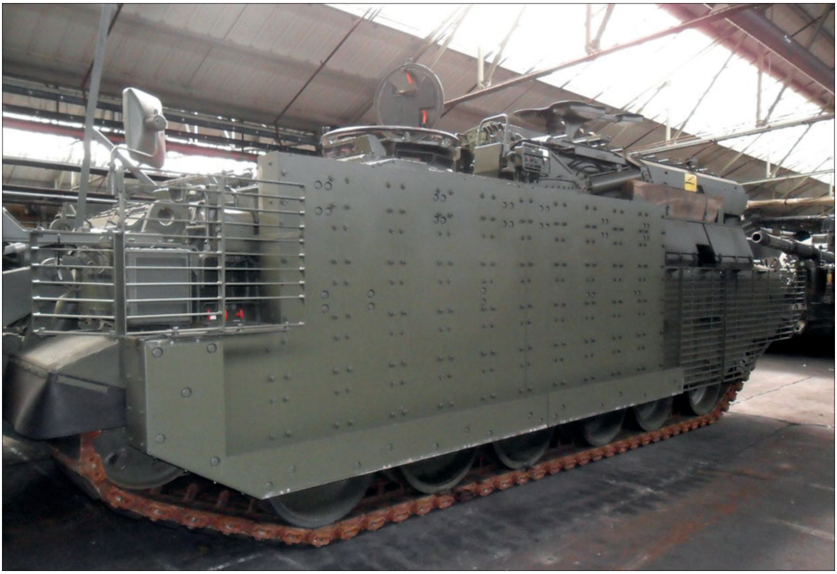


The suspension arms are separate and slightly more robust. The inner wheels are then fixed to the arms. The final drive housings for the sprockets are separate (there are four supplied) as are the idler arms. Also included are the attachment bars for the side skirts. The spare barrels are simple affairs with good definition on the retaining straps but the cradles lack detail.





The outer road wheels and tracks come as one moulding and actually are not that bad to look at. The wheels have good definition as do the tracks.



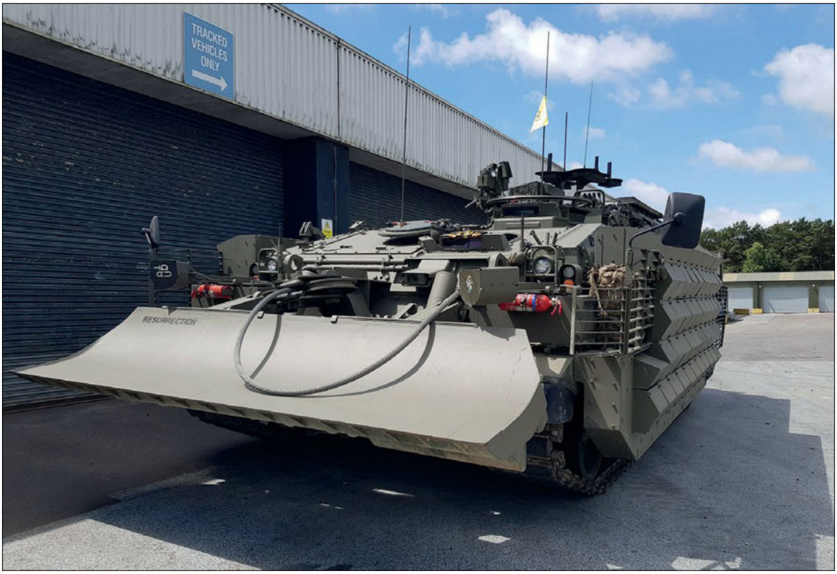
CRARRV with uparmoured side skirts. Notice the trough at the bottom which will take more armour, and the bar armour around the rear sections. (Rob Griffin)

Tow rope stowage on a CRARRV. Also visible is the plastic cover for the fire extinguisher to hide the bright post-box red colour.(Rob Griffin)

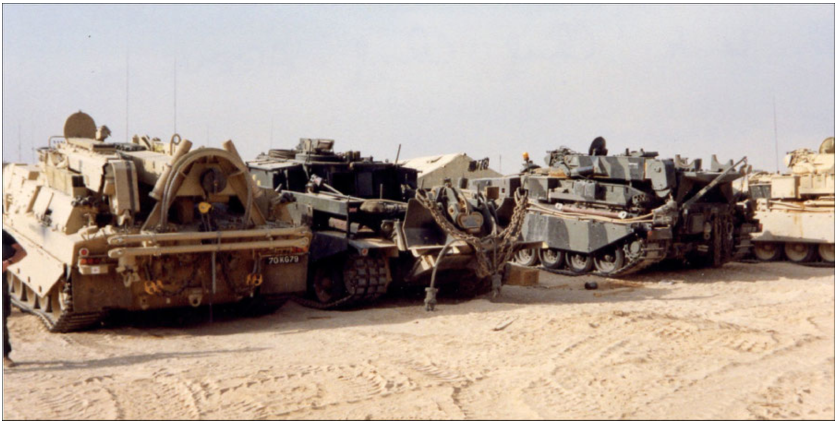
It is fitted with a small auxiliary winch which is used to help in deploying the main winch rope. As the CRARRV is also classed as a repair vehicle, to enable it to carry out repairs such as changing major components on the main battle tank, it is equipped with an Atlas crane capable of lifting 6,500kg (14,300lbs) at a distance of 4.9m (16ft). This is sufficient to lift a Challenger 2 power pack. On the front of the CRARRV is a large dozer blade, used either as an earth anchor when the Atlas crane is in use or to clear obstacles, but should not be confused with the role of the dozer blade, when employed on the Challenger.

CRARRV is powered by the Mk 3 CV12 power pack and is fitted with a different gearbox, the David Brown TN54, which gives six forward gears and two reverse, compared to the four and two of the Challenger. A specially developed trailer known as the High Mobility Trailer is used by the CRARRV to carry one CV12 power pack for Challenger, Titan or Trojan AFVs and two packs for Warrior infantry vehicles. All this is supplemented by the vast array of tools carried on the vehicle such as wooden blocks, welding gear and a man-portable ultra-thermic cutting system, along with traditional welding equipment. To recover dead vehicles the CRARRV uses an A-frame bar, which is also carried on the rear plate of the Challenger, once the frame is assembled the point of the A is attached to the tow pintle on the CRARRV and the lower legs are attached to the towing points on the left and right of the lower tank glacis.

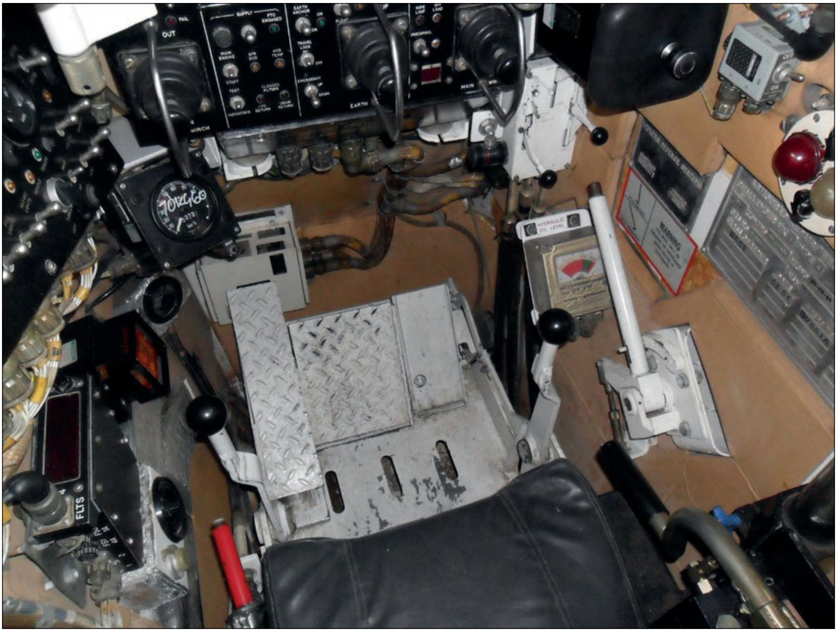
The introduction of the CRARRV was more exciting than usual. As it was nearing completion and thus service with the British Army, the Gulf War started. The first production model was delivered to the army in June 1990 and once all the trials had been completed it was expected to be formally accepted in or around May 1991. It also had to be confirmed that the United Kingdom would be playing a role in the forthcoming Operation Granby and that its Challengers would be used in the environment for which they were originally designed. It was accepted that tanks would break down or be knocked out. Those vehicles would of course need recovering especially those that could be repaired. Chieftain ARRV and even Centurion ARVs were slated for the Gulf but it was felt they were probably going to be hard pressed to support the Challengers and were by now a bit long in the tooth.



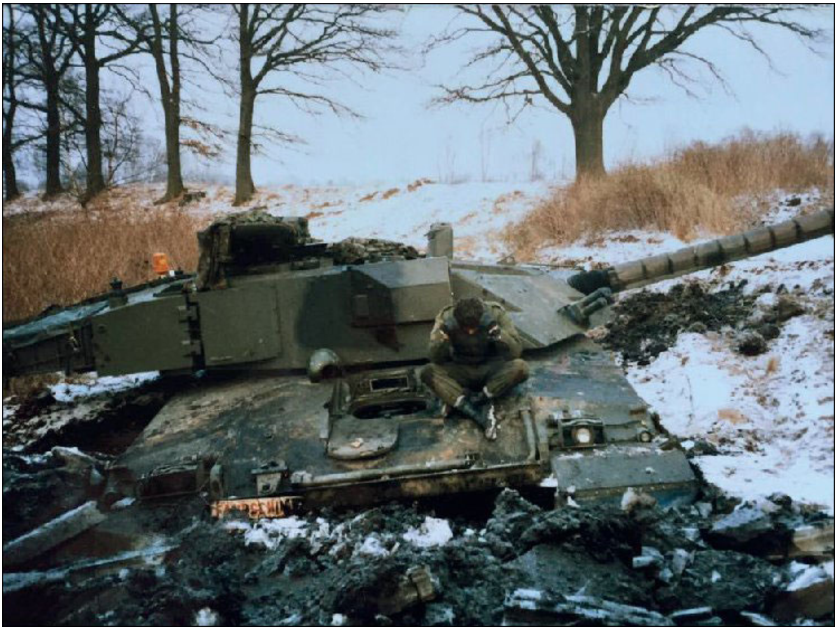
CRARRV sporting the full side armour. Located at the front is some of the newly classified anti-IED equipment.(Dave H Marcus)



A brilliant image of the recovery vehicles of the British Army taken during Operation Granby. The best part of this is it is unusual to see a replacement, with its replacement, all in service simultaneously. Left to right: CRARRV, Centurion ARV and CHARRV. (Dennis Lunn)

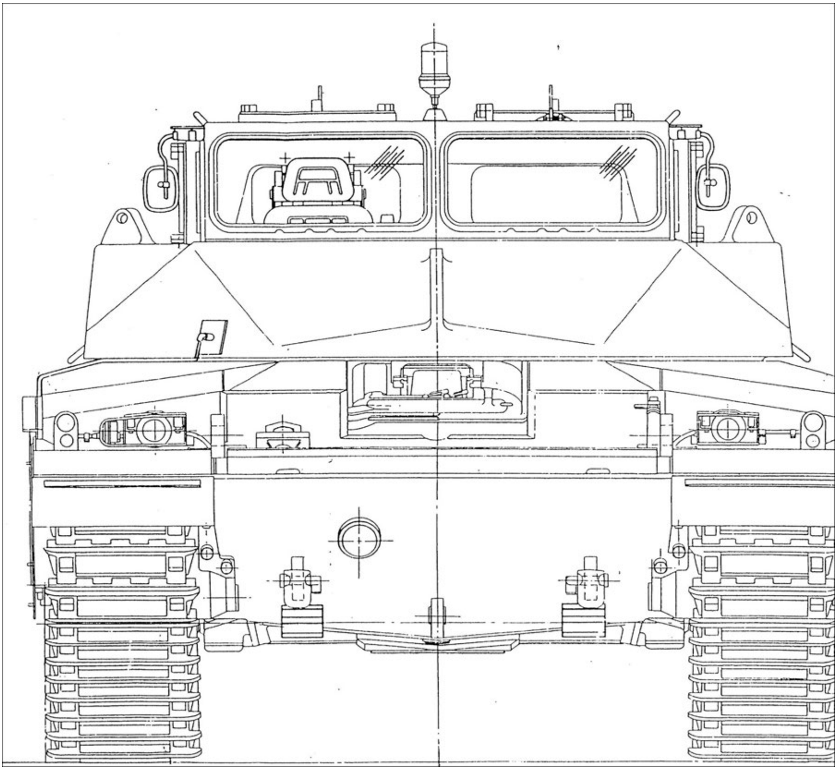


Driver's cab inside a CRARRV. The steering levers can be seen either *side of the seat. The cab is well laid out but still looks very complicated. (Rob Griffin)*



One can only imagine what this poor driver is feeling after this monumental bogging. Even worse though as the German word farschule meaning learner can just be made out on the right wing. (Paul Wesley)

The decision was taken to deploy the Challenger CRARRV even though it was not officially in service. In the end twelve CRARRVs were deployed and in a twist the first four were actually landed a day ahead of the Challengers, making them the first pieces of heavy United Kingdom armour to be landed in the Gulf. All twelve were given names and the media quickly latched onto this, especially as one was called Big Geordie. During the time in the Gulf the vehicles performed exactly as designed and earned a reputation for strength and reliability among the allied forces. The CRARRV seemed to be able to cross and cope with the soft sand better than most other tracked armour and was often in demand to recover bogged-down tanks. Once the war was over the CRARRVs returned to the United Kingdom where they were fully reworked, and lessons learned were implemented. The fleet eventually reached 74 for the British Army although 80 were built: the others were used in trials and development and never issued to the army. Four further vehicles were built and sold to Oman to go with its fleet of Challenger 2s. Currently it is the most powerful recovery vehicle in its class. Although names were given to those vehicles that were sent to the Gulf, they were unofficial, and although Vickers used the name Rhino in its publicity material and the press picked up on it, the name was never officially adopted.

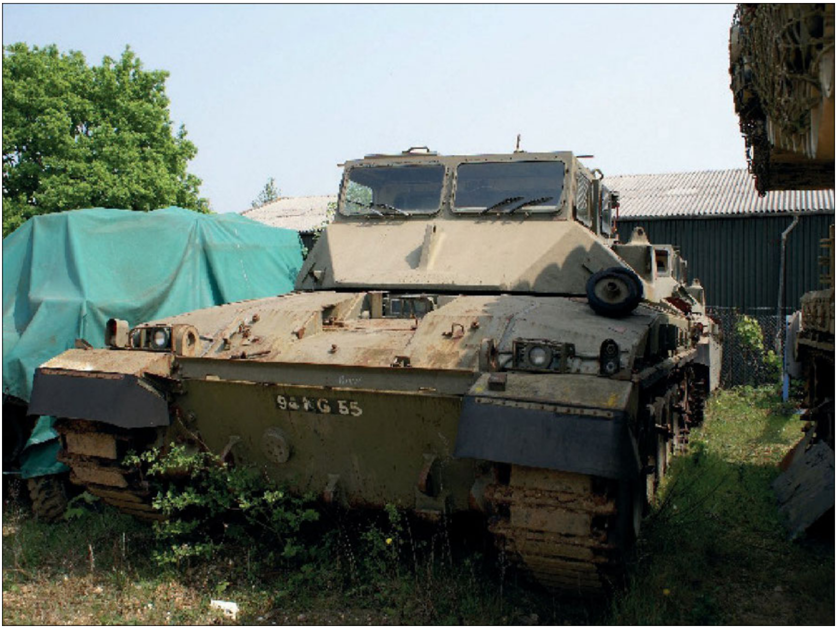


Head-on view of the driver training tank. The instructor's seat can be seen clearly in the control cabin. Note also this vehicle has the removable cover on the toe plate to allow the electric cables, for fitting the dozer blade, to be fed from inside the hull. (Crown Copyright

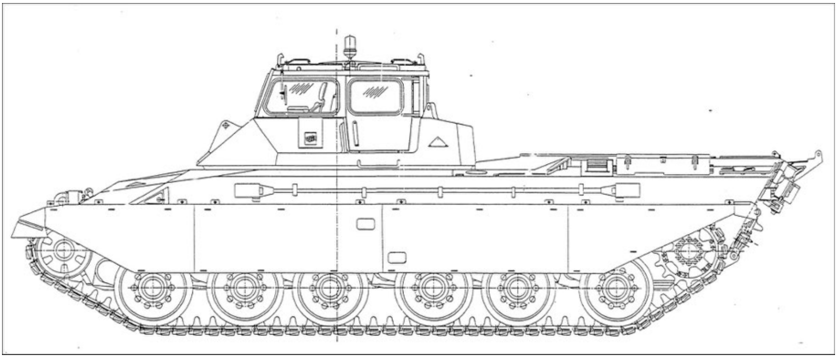
Reserved)

The second variant based on the Challenger hull is the Challenger Training Tank (CTT). These were the first vehicles of this type to be ordered for the British Army, although countries like Germany had been using them for a long time. In its simplest form a specialist turret is fitted instead of the standard gun turret, which gives the instructor and trainees cover from the elements making teaching a lot easier. It also has a set of controls to allow the instructor to control the vehicle or introduce faults. It is a far cry from the normal way of instructing learner drivers that had been in place since at least the Second World War: take one tank, put one learner in the driver's seat, two more in the turret with the instructor and away they went, regardless of the weather. So often the trainees were more interested in keeping warm than watching and learning. It did not help that once in the BAOR they would watch their Bundeswehr colleagues, zooming along the roads in the converted Leopard tanks, with the turret removed and fully enclosed training turret fitted, keeping warm and dry.

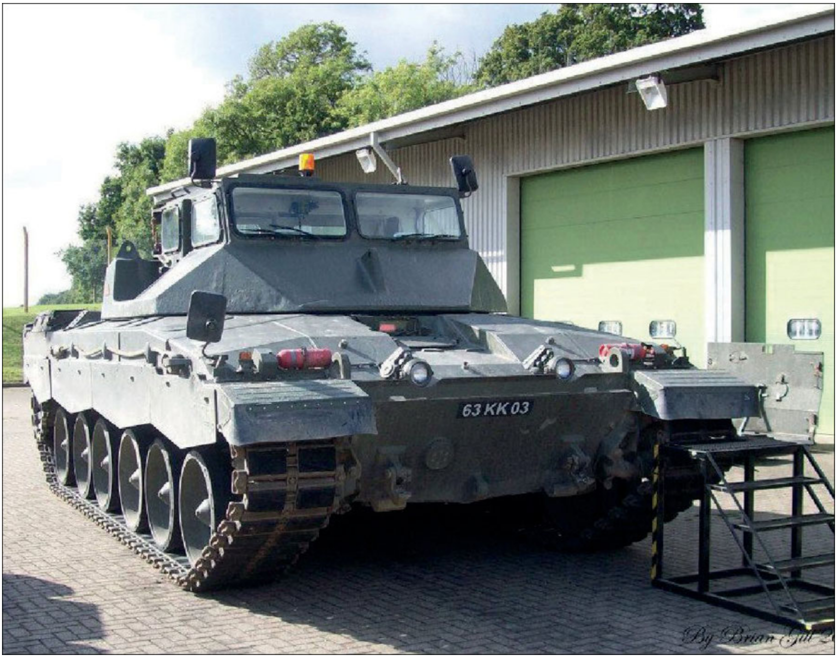
It is amazing it took the United Kingdom MoD so long to realise the advantages of such a system; using service gun tanks proved to be expensive, with the added risk of damage by trainees. In the event an order for seventeen Challenger Training Tanks was placed. The vehicle is based on a conventional Challenger hull, which is weighted to give the whole vehicle the heaviness and feel of a service vehicle. Hull construction was the same as a gun tank but with bits missing or modified. The layered armour under the cosmetic plate was mild steel but the hull structure was armour. The instructor had a control panel with various warning lights, as well as a footbrake that could be used in an emergency, but apart from all that he had no way of controlling the vehicle apart from an emergency engine cut-out switch that was also found on the gun tank and had been in Chieftain. When this switch was activated it cut the engine and the tank slowly ground to a halt. While this was a big step forward in training learner drivers, compare it with the civilian equivalent; your instructor more than likely will have dual controls apart from steering, but they are positioned next to you and in the event of you doing something really foolish could grab the wheel to avoid an accident. Then consider the tank driving instructor; although he has a dry turret and padded seat, is a long way from the learner driver way down in the front of the tank. In the event that something is not going well all he can do is use his footbrake and hope that will be sufficient.



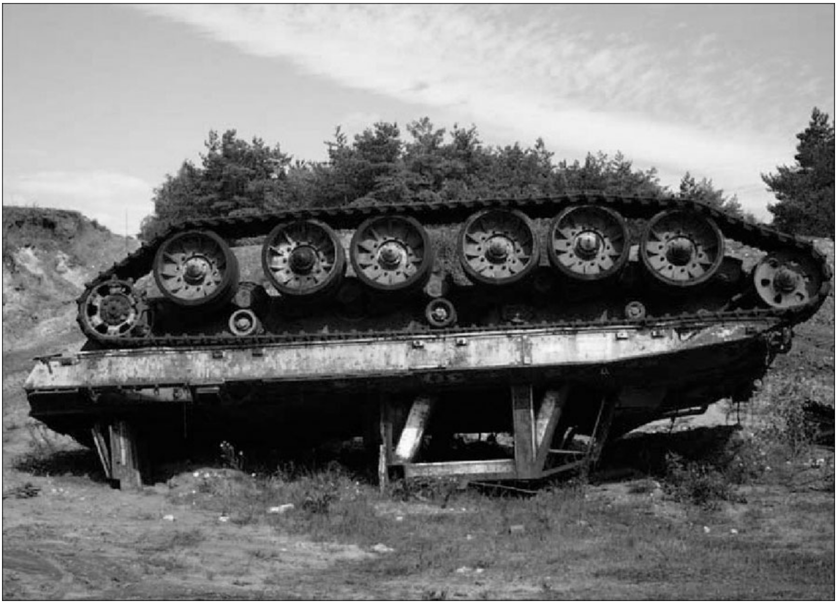
This low-resolution image shows 94 KG 55, one of a pair of driver train conversions held at the Tank Museum. Of note is the good view of the glacis and armour around the cab and also the shape of the fixed cab for the instructor and trainees. (Martin Coles)



A drawing showing the left-hand side of the driver training tank. (Crown Copyright Reserved)



Driver training tank, showing to good effect the conversion with the enclosed turret for the instructor and the trainees, a far cry from all being exposed to the elements. (Challenger Tank Appreciation Society)

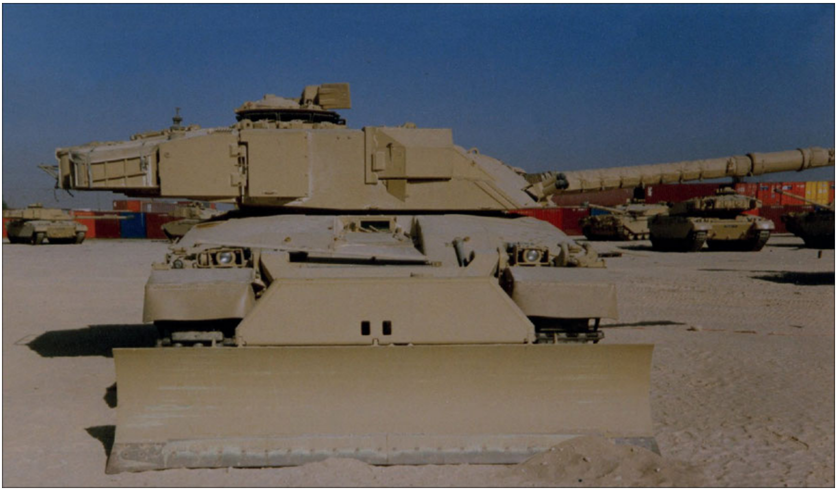


Another of the gems that could be found on Bordon Heath, this time one of the prototype driver training vehicles. This does show remarkably well just how tough the crew compartment was in the event a learner managed to roll the vehicle. (Rob Griffin)

The actual turret is constructed of unarmoured steel and will have the familiar red 'warning not armoured' triangle located on it. It has hinged doors either side of the turret, which are fixed to allow access, along with a roof hatch. These all have quick-release pins to allow them to be easily removed in the event of an accident. The turret is equipped with a control panel with various warning lights so the instructor can monitor the state of the vehicle. Handheld fire extinguishers are fitted as are wing mirrors on the front edges of the turret. Seating for the instructor and two further trainees is provided. To ensure the safety of all involved and to demonstrate the rigidity of the turret, a Challenger hull fitted with it was deliberately rolled over until it was resting on the turret roof.

The turret remained firm, and if the crew had been inside they would have been able to remove the pins holding the side doors and escape safely. The concept proved very popular and was carried over to the Challenger 2.

These then are the specialized variants that were built around the hull of the Challenger, and due to its short service life those were all that made it into service. However, the Challenger, like all the tanks preceding it, was used to trial various options. This is quite a common use of the hulls of tanks and even today there are some Chieftain hulls soldiering on, although possibly looking nothing like the battle tank that we all know. Even the Conqueror Heavy Tank was used for various trials and other tasks with the last leaving service in 1986 – not bad for a tank withdrawn two decades earlier. Some of the trials and equipment loaded onto these hulls range from the sensible to the downright bizarre, and only a fraction of these ever come to public attention.

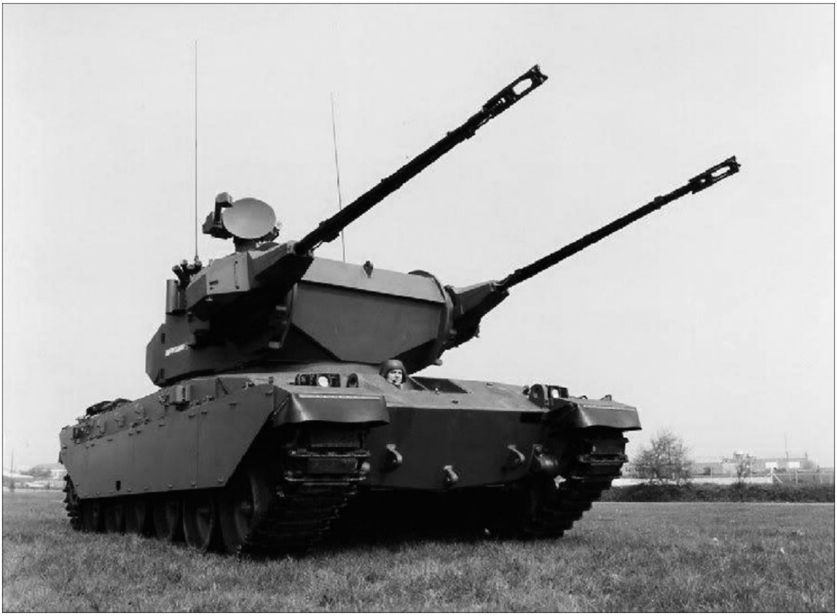


Challenger during Operation Granby fitted with the Pearson Engineering full-width dozer blade. Visible on the glacis plate is the metal cover for the hydraulic lines. (Dennis Lunn)

The Chieftain tank had the provision to be fitted by the crew, with

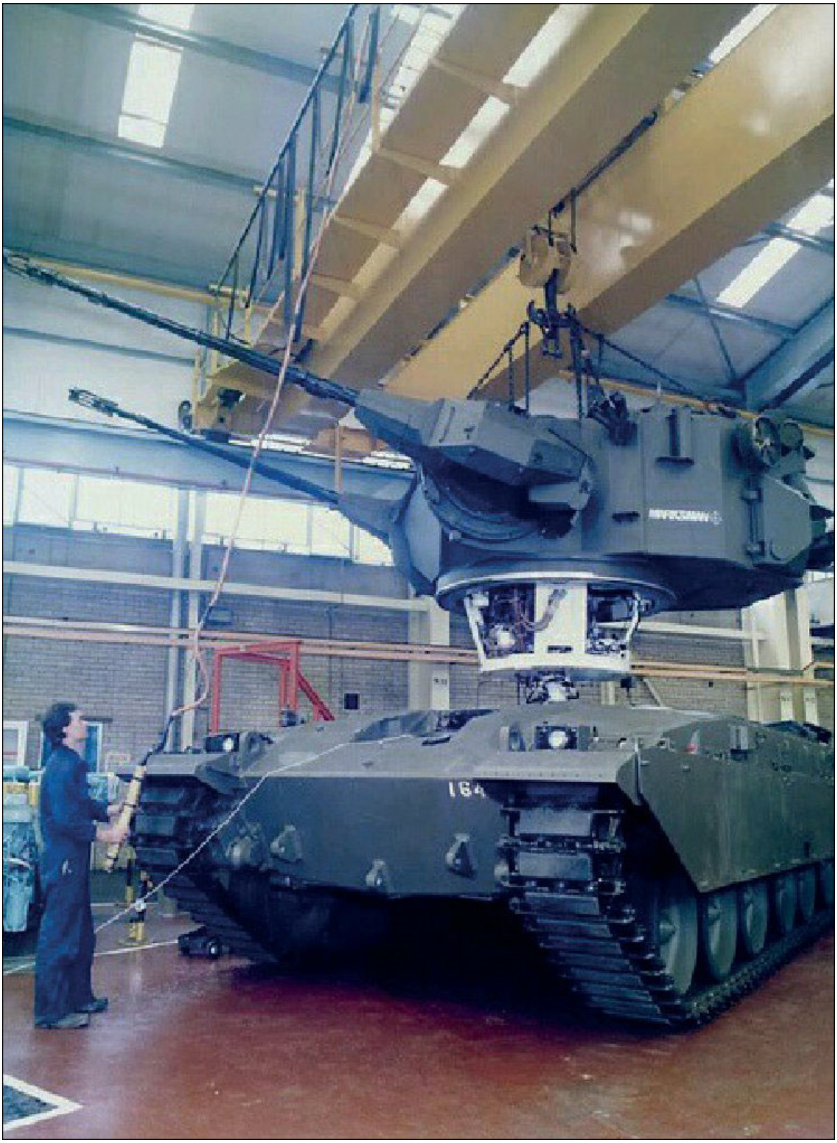
REME assistance, a hydraulic dozer blade. This was designed to be used for providing scrape fire positions for the squadron tanks and for clearing obstacles. It was normally mounted on the squadron's second-incommand tank. It was not a popular fitting and for most of its time was stored against a hangar wall out of the way, and was only bothered about for accounting purposes. In June 1987 trials commenced on fitting a Pearson Engineering Universal Dozer Kit, which by its very name means it should be able to be retro fitted to most tanks, with little modification. These initial trials were carried out on the venerable Chieftain and were fairly successful, so in January 1988 the Armaments and Trials Development Unit at Bovington began trials on the Challenger. In fitting the blade various modifications had to be made. The two most obvious were: two blocks welded one either side below the tow eyes and, the most visually obvious one, cutting a hole in the lower glacis plate which was required to run the electrical power leads to the blade, when not in use. This aperture which is on the left side when viewing the tank from the front, is covered by a circular access plate. Early production vehicles did not have this modification which can be used to reference their place in the build and marks of the Challenger. The whole assembly comes as a self-contained unit ready to use, the blade in use is easy to operate and is controlled by a box located in the driver's cab with a simple joystick located on the box. When not in use the blade will be raised and travelling locks secured. The blade placed extra weight on the nose of the tank so it was found that the front three Hydrogas suspension units had to have their operating pressure increased to compensate for the extra weight. One knock-on effect of fitting the dozer blade was that it was now necessary to load the tank onto their transporters in reverse and in the event of the tank breaking down it has to be recovered in reverse. Other items were the relocating of the track tools from the glacis to other places on the tank. In use the blade is very effective and using the 3.78m blade a reasonable tank scrape can be constructed in around ten minutes; it must be borne in mind that the tank scrape is literally just that, and not the full-blown deep hole that would normally be constructed by Royal Engineers' earth moving equipment. Tank blade kits were sent to the Gulf where it was thought they would be of use in destroying the sand berms the Iraqis had constructed.

The second trial vehicle was probably never designed to enter service with the British Army, and that was the Marksman anti-aircraft turret. The British seem to have an ‘it will be ok on the day’ attitude to air defence, despite it being vital to any sort of troop movement. The Battle of the Falaise Gap in the Second World War showed this and in more modern times the Falklands and both Gulf wars. There is no real dedicated air defence system in service at the moment. Chieftain trialled two different turrets and the acclaimed FV432 had a version called Falcon, all of which provided information and were then discarded. The Challenger was fitted with the Marksman turret which is a British air defence system developed by Marconi, consisting of a turret, a Marconi Series 400 radar and two Swiss Oerlikon 35mm autocannons. Its shape and use is very similar to the German Gepard system. The beauty of the system is that it can be readily mounted on most tank chassis, with very little modification. Sometimes it is necessary to fit an adaptor ring but that is about all. The turret can be adapted to many basic tank chassis to create a self-propelled anti-aircraft gun. The only current operator of the system is the Finnish Army, which ordered seven units in 1990. The turrets were fitted on Polish T-55AM tank chassis. It is considered to be a very accurate anti-aircraft system, and it is claimed to have a hit rate above 50 percent. One turret was fitted to a Challenger hull and it conducted all the normal trials that would be expected of it. Manufacturers claimed that providing the Challenger main turret was already removed, they could fit Marksman and have it running in around one hour. The weapons used in the Marksman are two Oerlikon 35mm cannon, whose rate of fire is listed as 18 rounds per second, firing out to a maximum range of 4,000m. Full traverse of the turret is possible, the ammunition carried is 460 fragmentation rounds and 40 anti-tank rounds, although this could vary due to operational requirements.



The Marksman air defence turret on a Challenger 1 hull. The first impression is how big it actually is. (Paul Jones)

A typical Challenger on exercise. The cables running down the turret front and the object hanging from the gun, are all part of the Direct Weapons Effect Simulator, the successor to the much-maligned Simfire and Simfics from Chieftain days. It allows vehicles to engage each other and if all is correct to be able to score a 'kill'. (Mike Seymour)



Fitting the Marksman anti-aircraft turret to a Challenger hull, which according to the manufacturers takes only thirty minutes to complete, but that is after the normal turret has been removed. (Trevor Gray)

One final variant that was to be seen was a Challenger with no conventional turret but a rather blocky round turret which is known as a Windsor turret, so called after the castle of the same name. This is usually fitted when either no service turret is available or for testing all up weights for a project. The Windsor turret can be weighted to simulate many different requirements.

In Service and In Action

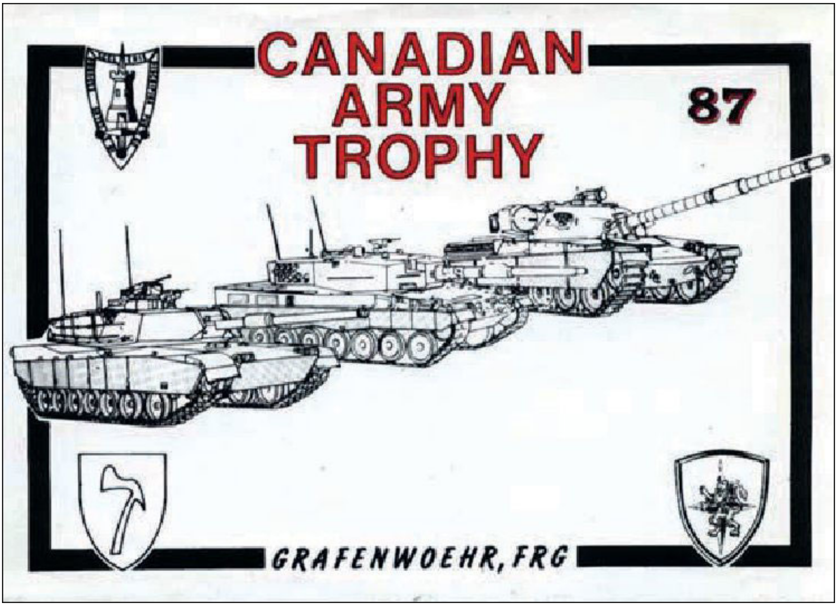
Come 1987 the regiments assigned to Challenger were happy with their new steed. The media, civilian and forces, such as Soldier Magazine and the forces news programmes in BAOR, were running articles singing its praises. Soon the chance came to show how good Challenger was and what a world-class tank the British Army had: it was time for the Canadian Army Trophy competition. This was a competition held in Germany among the NATO tank forces. It started in 1963 when the Canadian government presented a silver model of a Centurion to be competed for. Originally it was held every year but in 1977 it was decided it would be held every two years at the NATO ranges at Hohne; however, by 1987 the competition had moved to the ranges at Grafenwöhr. Some nations select their team and train solidly for a year while others, including the United Kingdom, select the regiment about three months before. This meant a lot of changes and sourcing kit and selecting crews, all detrimental to the normal regimental training. When the 4th/7th Royal Dragoon Guards were selected (they came third with Chieftain in 1979) they were training on the Soltau training area and had to be brought back to form a CAT Squadron, pick the best crews and have the choice of the regiment's Chieftains, while still trying to keep to normal commitments.

Thus in 1987 the two Challenger regiments selected, from which the winners would be pulled from a hat, were 2 Royal Tank Regiment who, during the precompetition training that both regiments had to complete, performed best with consistent good scores. However, their Challengers were still not fitted with the TOGS system, which meant they were not getting the best from the tank. The second regiment was the Royal Hussars who actually had a squadron of TOGS-equipped Challengers, but these were in the British Army Training Unit Suffield in Alberta Canada carrying out the Medicine Man training package, and thus they were using Chieftains and not Challengers. To try and alleviate the issue of no

TOGS, twentytwo brand new Challengers, complete with TOGS, were diverted from the production line, but from this point on things did not proceed auspiciously.

Those responsible had really believed that the tank was a winner, when in reality, inside the turret, it was nothing more than an upgraded Chieftain fitted with TOGS and various modifications. One such was the Chase modification, designed by Staff Sergeant 'Charlie' Chase 4/7RDG, this design meant that when the loader's safety shield was pulled to the rear, the breech closed, instead of the loader having to pull on the closing lever: a good modification and a time saver. The fire-control programme was tweaked to try and improve it, but to the end of the competition it was never correct. Come the draw from which everyone hoped that 2 RTR would win the Royal Hussars' name came out of the hat. All then pulled together to provide the best support to the Hussars. During the actual competition the Royal Hussars produced some very credible scores, including one they thought could not be beaten. Sadly they actually came a very poor last. The scenes on the ranges and the political fallout was horrendous. One senior British officer was seen to storm off the range and leave before the presentations which led to the United Kingdom press launching scathing headlines such as 'NATO allies outgun Britain's new wonder tank'. Heads were called for and morale was low in the Royal Hussars, although they had nothing to be ashamed about, Challenger was just not up to the job when pitted against the latest Allied tanks.

However, despite calls for scrapping and disbanding, the Regiment and Challenger emerged from the fiasco and soldiered on. Many jokes were made about not wanting to go to war in Challenger, but very soon world events would see the prophets of doom proved wrong and Challenger totally vindicated. Possibly the last word should go to Ian Stewart who was Minister of State for the Armed Forces at the time, 'I do not believe that the performance of tanks in the artificial circumstances of a competition, such as the recent Canadian Army Trophy, is a proper indication of their capability in war.' He could not have known how prophetic his words would be. Following this the United Kingdom withdrew from the competition in December 1987.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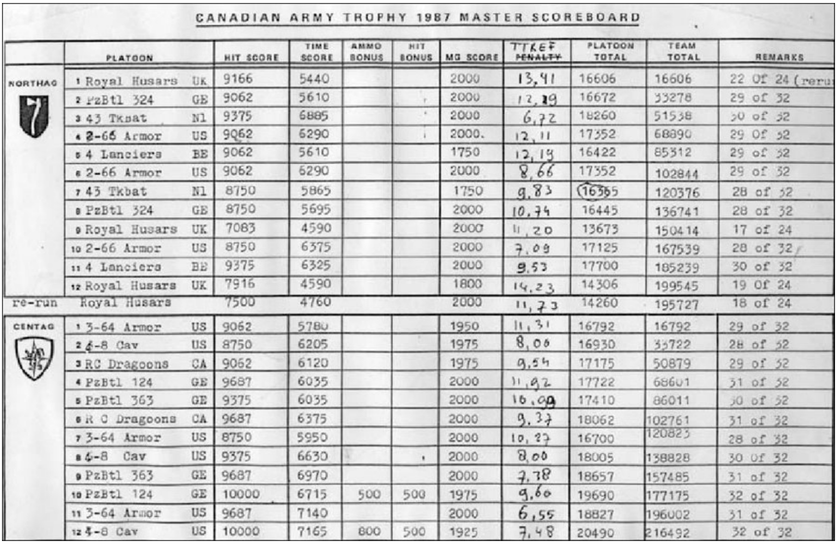
A badge that many associated with Challenger would prefer to forget. It's interesting to note that although Challenger took part in this competition it is Chieftain that is depicted on the image. (Wikipedia Commons)



CANADIAN ARMY TROPHY 1987 MASTER SCOREBOARD

	PLATOON		HIT SCORE	TIME SCORE	AMMO BONUS	HIT BONUS	MG SCORE	TTKEF ~~PENALTY~~	PLATOON TOTAL	TEAM TOTAL	REMARKS
NORTHAG	1 Royal Husars	UK	9166	5440			2000	13,41	16606	16606	22 Of 24 (reru
	2 PzBtl 324	GE	9062	5610			2000	12,19	16672	33278	29 of 32
	3 43 Tkbat	Nl	9375	6885			2000	6,72	18260	51538	30 of 32
	4 2-66 Armor	US	9062	6290			2000.	12,11	17352	68890	29 Of 32
	5 4 Lanciers	BE	9062	5610			1750	12,19	16422	85312	29 of 32
	6 2-66 Armor	US	9062	6290			2000	8,66	17352	102844	29 of 32
	7 43 Tkbat	Nl	8750	5865			1750	9,83	16365	120376	28 of 32
	8 PzBtl 324	GE	8750	5695			2000	10,74	16445	136741	28 of 32
	9 Royal Husars	UK	7083	4590			2000	11,20	13673	150414	17 of 24
	10 2-66 Armor	US	8750	6375			2000	7,09	17125	167539	28 of 32
	11 4 Lanciers	BE	9375	6325			2000	9,53	17700	185239	30 of 32
	12 Royal Husars	UK	7916	4590			1800	14,23	14306	199545	19 Of 24
re-run	Royal Husars		7500	4760			2000	11,73	14260	195727	18 of 24
CENTAG	1 3-64 Armor	US	9062	5780			1950	11,31	16792	16792	29 of 32
	2 4-8 Cav	US	8750	6205			1975	8,06	16930	33722	28 of 32
	3 RC Dragoons	CA	9062	6120			1975	9,54	17175	50879	29 of 32
	4 PzBtl 124	GE	9687	6035			2000	11,92	17722	68601	31 of 32
	5 PzBtl 363	GE	9375	6035			2000	16,09	17410	86011	30 of 32
	6 R C Dragoons	CA	9687	6375			2000	9,37	18062	102761	31 of 32
	7 3-64 Armor	US	8750	5950			2000	10,27	16700	120823	28 of 32
	8 4-8 Cav	US	9375	6630			2000	8,00	18005	138828	30 Of 32
	9 PzBtl 363	GE	9687	6970			2000	7,78	18657	157485	31 of 32
	10 PzBtl 124	GE	10000	6715	500	500	1975	9,60	19690	177175	32 of 32
	11 3-64 Armor	US	9687	7140			2000	6,55	18827	196002	31 of 32
	12 4-8 Cav	US	10000	7165	800	500	1925	7,48	20490	216492	32 of 32

The scoreboard tells the sad tale.

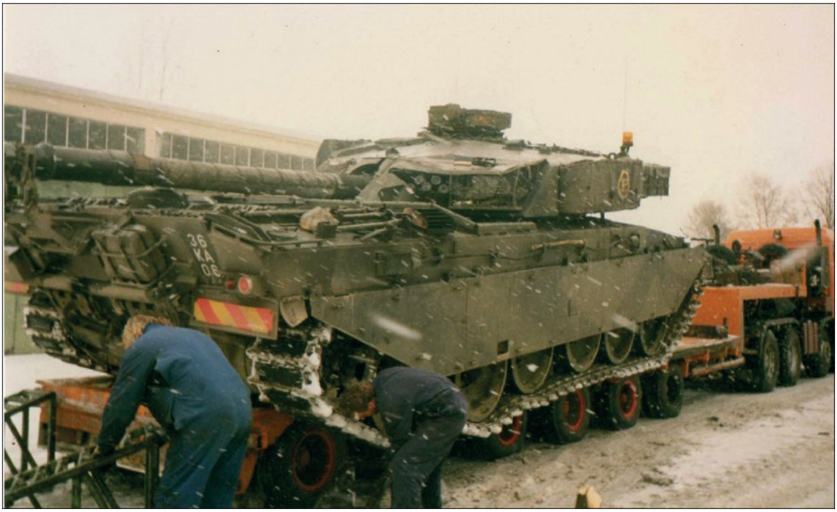
Challenger in its natural setting. This has the look of the old Soltau Training Area in BAOR before it was handed back to the Germans: woods and lots of muddy tracks. (Andrew Ingham)

On 2 August 1990 Saddam Hussein invaded Kuwait, in continuation of his claim that Kuwait was, and always had been, part of Iraq. Working from the intelligence he was given that, although the Western powers might well raise diplomatic scenes and get involved in a bit of sabre rattling, that is all they would do, he was emboldened by the fact that once he was actually in Kuwait that would be the end of it as far as the West was concerned. As history shows he could not have been more wrong. Heroic defence by the Kuwaiti Military Forces included some good television coverage of the venerable Saladin armoured car engaging targets in a built-up area and the 35th Brigade with 35 Chieftain tanks doing what they were designed for: taking on masses of Sovietbuilt armour and inflicting heavy casualties for the loss of only two Chieftains.

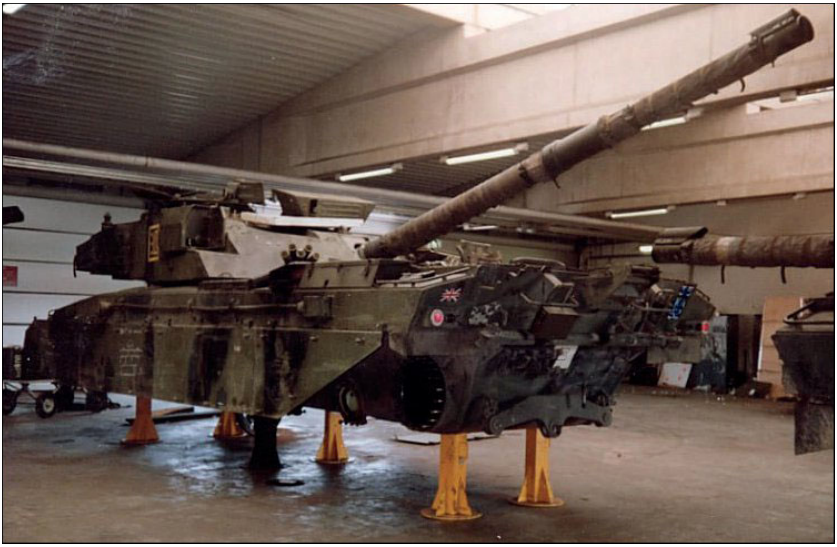
Typically, the British squaddie had rumours flying and soon it seemed that all units were going to the desert. For most this was all it was, a rumour. In the end it was decided to send the 7th Armoured Brigade, the Desert Rats, consisting of the Royal Scots Dragoon Guards (Scots DG) and the Queen's Royal Irish Hussars (QRIH), both equipped with Challenger. Behind the scenes the legacy of CAT 87 still lingered and the Prime Minister, Margaret Thatcher, held a meeting where she asked defence chiefs and heads of Vickers, whether Challenger would perform and not become yet another embarrassment. They all gave their word that it would indeed perform. Thus satisfied, the PM set out to convince the Cabinet that all would be well and war was different to competitions. This she achieved and from then on some rapid logistic work took place to ensure that only the best took part. However, this did manage to cause its own embarrassment, when the press discovered that in order to send the Challengers to the Gulf, spares, including suspension units and power packs, were harvested from Challenger 2s. This led to the now infamous picture showing the inside of a tank hangar in BAOR with all the Challengers 'on blocks'.

In total 221 Challengers were sent to the Gulf with 7th Armoured Brigade being the first, followed later by 4th Armoured Brigade which was infantry-heavy and only had the 14/20th King's Own

Hussars as its armoured regiment. Vickers Defence Systems began producing a number of conversion and upgrade kits to enable the tanks to cope in the desert. Included were the armour upgrade packages, although not all tanks received these as photos of the tanks in the Gulf show them in many different configurations.



It seems that the width of the Challenger had not been taken into account when loading it onto this Dutch transporter. This will be a nightmare to sort out, and it is snowing. (David Merry)



No wheels on my waggon. The scene in several regimental hangars after equipment was removed from Mk 1 and Mk 2 Challengers to provide spares for the Gulf War.

Once the tanks had arrived they were sent through the upgrade system being manned by a team from the various manufacturers and the REME, most of which was carried out on the quayside area at Al Jubayl in Saudi Arabia. The main features fitted were the armour packs of Chobham armour for the hull sides and explosive reactive armour for the toe and glacis plates, also fitted were the external fuel drums.

Despite the units having the most modern versions of Challenger available, 90 percent of the Challengers used by the Scots DG came from other units: this was a bit like the CAT 87 team having the pick of the best. One concern was that although Challenger owed its existence to a tank designed to fight in the desert, it was built to operate in a temperate climate. Prior to the deployment only around 22 percent of Challengers in the fleet were considered operational, a lot of this was due to lack of spares and ongoing faults. This was soon to change and the crews were amazed at what resources were being pulled out for them: a part was requested and it was sent as fast as possible.

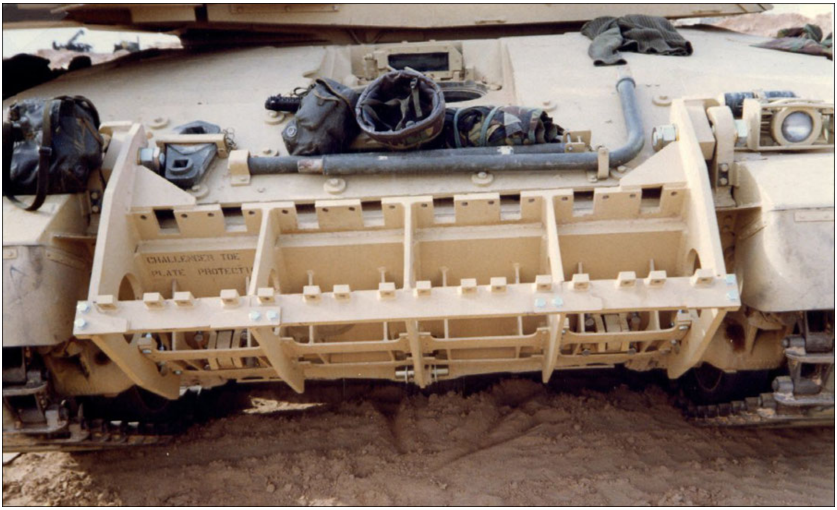
In one instance during an exercise in BAOR to test just such a scenario, crews were told what damage had taken place and to order replacement parts. Instead of the usual piece of paper, they received actual parts, especially tools. However, due to the hurly-burly of exercise life they somehow managed to 'get lost'.

The arrival of 14/20th with their Mk 2 Challengers meant the process starting all over again. The charge bins were replaced with the armoured versions and the add-on armour was applied. One other fitting that some tanks received was the dozer blade.

This usually spent its life lurking in the rear of tank hangars as it was not a popular fitting. Although it added nothing to the frontal protection, it was reassuring in that it was used to dig tank berms and proved quite good at it. The tanks had received their striking colour of desert yellow, although its correct name is light stone, and had the Coalition black chevron painted on the armour sides. Desert Rat silhouettes started to appear on the vehicles too.

LONG VEHICLE
LONG VEHICLE
54 KB 16

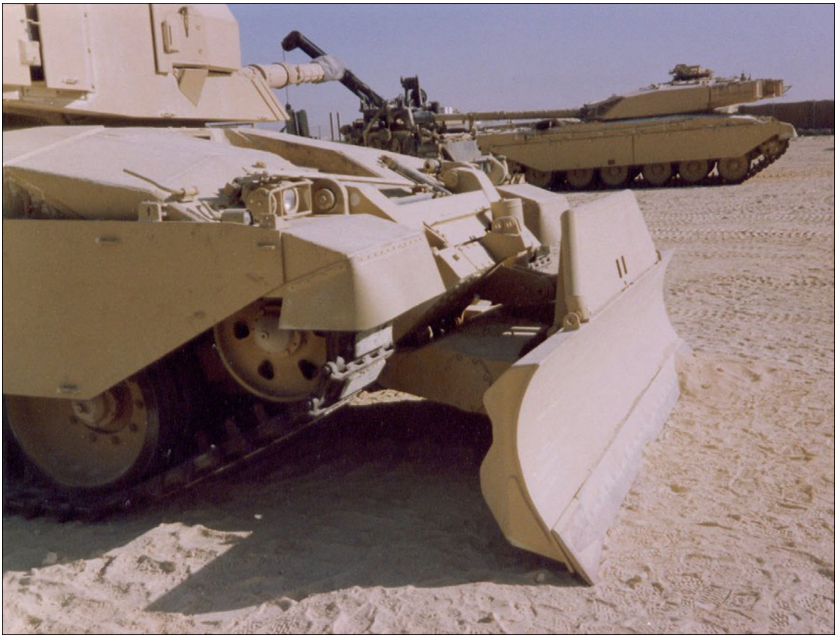
To save track wear tanks are often moved either by warflats on the railway or as seen here, during Desert Storm, by tank transporters. The *transporter crews have the loading and unloading down to a very slick art. (Dennis Lunn)*



The cradle for the toe plate protection, not often seen minus its Explosive Reactive Armour (ERA). Note at left top the stencil writing explaining what it is.

(Dennis Lunn)

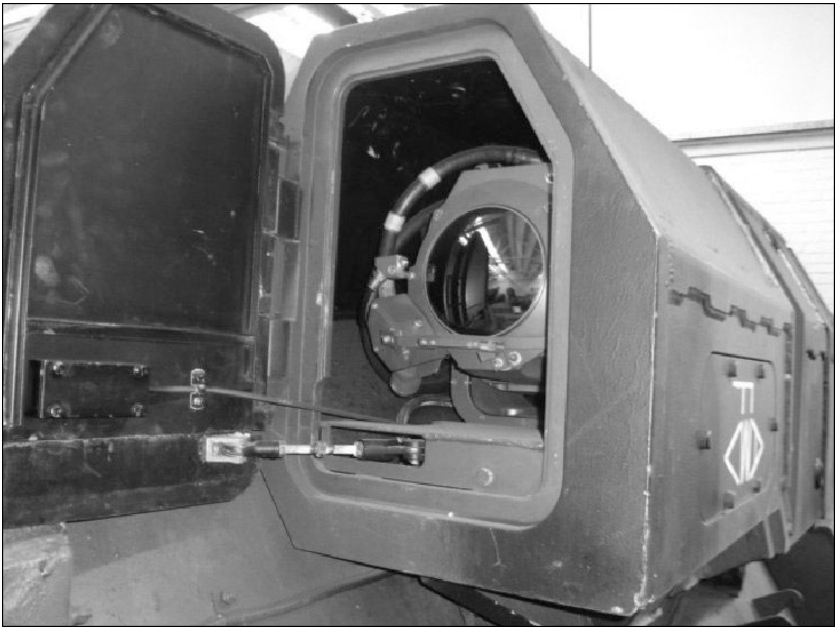
It was decide that the 1st Armoured Division, which consisted of the Challenger regiments, would be under command of the United States VII Corps. Some felt that this was not a good move as they did not trust the Challenger due to its CAT 87 history, but these dissenting voices were in the minority. When Brigadier Patrick Cordingly first met the American commander, General Boomer said, ‘I can’t tell you how happy I am to see you.’ The United Kingdom had the one thing he was lacking, and that was tanks. His marines only had 120 tanks and not a lot of armoured engineer support, so the deployment of 60 Challengers with their 120mm guns and Chobham armour was most welcome.



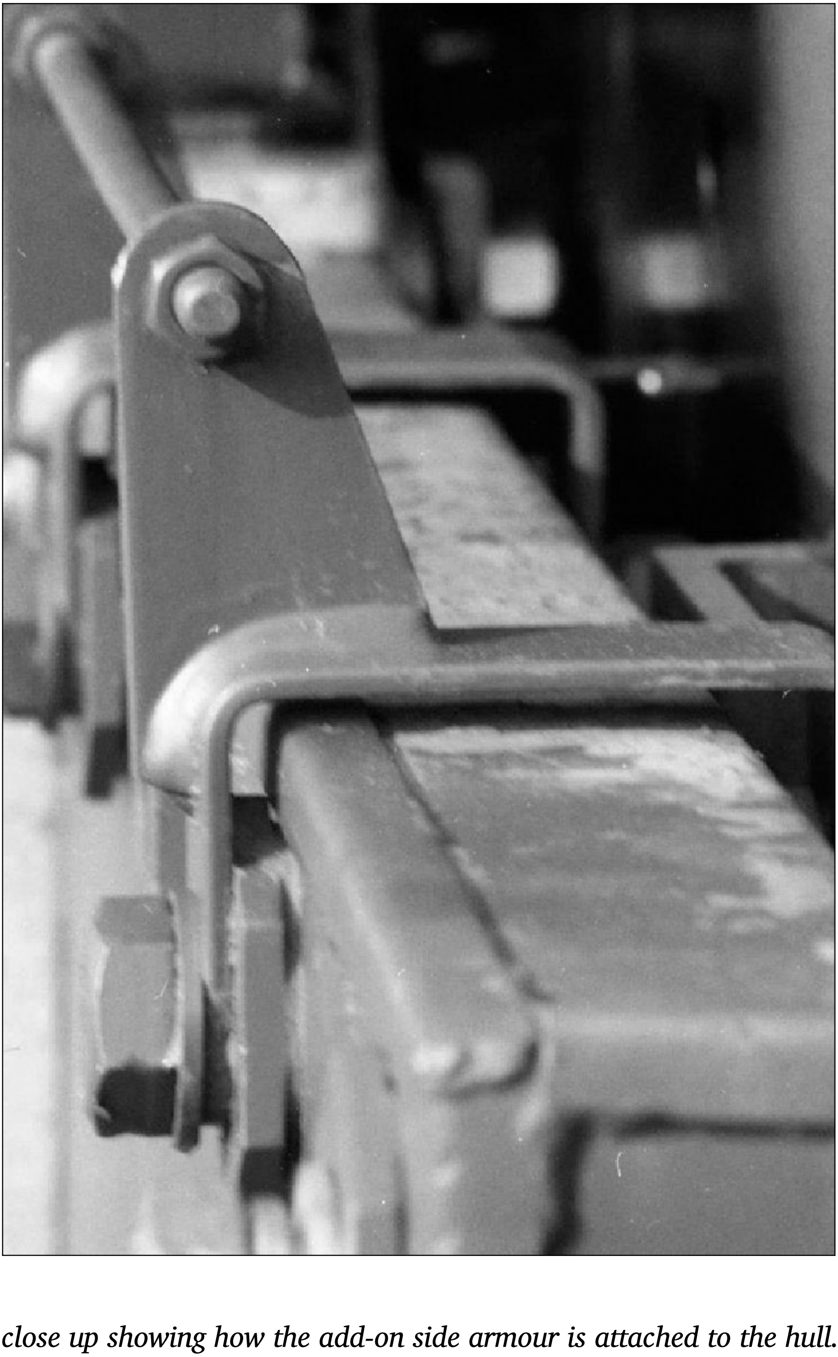
Side view of the dozer blade showing the fittings better. Only one tank in a squadron carries this and it is usually the squadron 2i/c that does so. (Dennis Lunn)

The ground war for the armoured regiments and their Challengers started at 10h00 on the 25 February 1991, although the other forces had crossed the border the day before, the armour had moved to their forward assembly areas and waited to be called to battle. Tanks from 7th Armoured were the first to move out followed by 4th Armoured at 19h30.

Challenger during the Gulf War. It looks as if they may well be expecting replenishment, judging from the poses of the crews. (Brian Gill)



A good view of the Thermal Imaging Sight Head (TISH) in its protective box. The wipe-wash system and door actuating ram can clearly be seen. (Rob Griffin)



A close up showing how the add-on side armour is attached to the hull. (Rob Griffin)

They conducted a left hook around the enemy positions as planned; as it was the eastern-most unit of VII Corps, its Challenger tanks formed the armoured spearhead with the task of destroying the Iraqi armour. The main threat to the Challenger was deemed to be the Iraqi Republican Guard's T-72M tanks. To counter this perceived threat, each Challenger was provided with a small amount of the L26A1 depleted uranium (DU) shells specifically for use against T-72Ms. During the course of the Coalition's ground campaign none were encountered as the division was withdrawn beforehand. One issue that arose from issuing the rounds that might not have been seen was that it gave the anti-war and nuclear weapons protestors 'ammunition' to protest about: the use of 'nuclear' weapons and that the public had not been told about this. As DU rounds are made from used nuclear fuel they are not an explosive device, so the cries were a bit unfounded.

The division advanced nearly 350km within 97 hours, destroying the Iraqi 46th Mechanised Brigade, 52nd Armoured Brigade and elements of at least three infantry divisions belonging to the Iraqi VII Corps in a series of battles and engagements. They captured or destroyed about 120 tanks and a very large number of armoured personnel carriers, trucks and reconnaissance vehicles.

Probably the war-winning feature for the tank crews was the use of TOGS and the Global Positioning System (GPS). During the war many of the tank laser sights that the Challenger depended on to give an accurate range to a target were faulty or not performing as they should. One major issue was the inability of the laser to penetrate the dust that was constantly being kicked up by the vehicles, thus the laser pulse fired from the sight were unable to return an accurate range. The TOGS system could see through the fog of war, but it did not have an accurate range system built in, apart from a stadiametric rangefinder in the sight. This was simply a curved line with ranges marked along it, and if the target fitted into a section of the curve then that was the range used, this system had been used by the Soviets for most of their tanks and it seemed to work for them.

One issue with TOGS was that although it could pick up a 'hot spot', identifying it as an enemy target was not so easy. As the vehicles involved in Operation Granby had no Identification Friend or Foe (IFF) system such as used on aircraft, tanks had to close the range to ensure that an accurate identification was obtained before firing, to avoid blue-on-blue engagements.

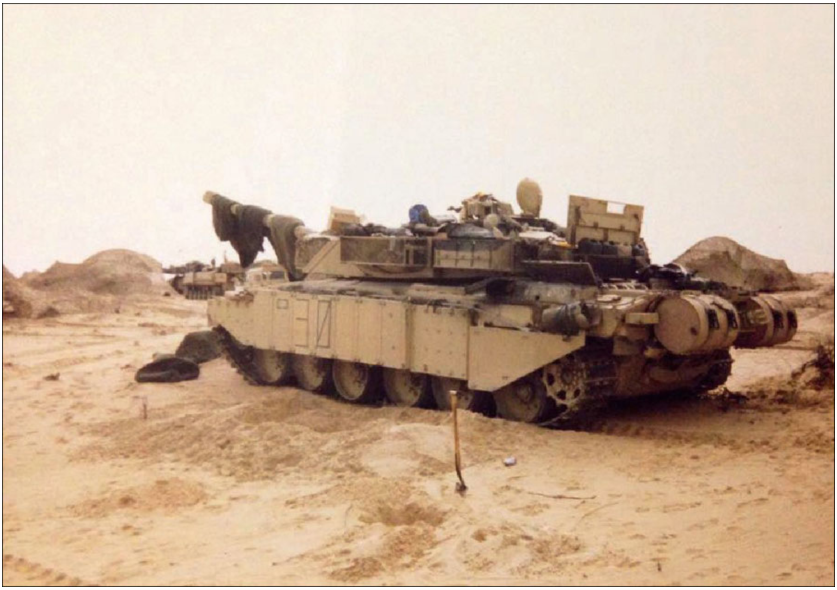
The other advantage for the crews was the use of GPS to establish locations. The majority of the crews were used to operating in Germany, Salisbury Plain or in BATUS Canada, where map reading was done the old-fashioned way by working out from a paper map where you were, although not always easy, especially on the Canadian prairie it was adequate. The desert however was a different game; with its flat featureless terrain conventional map reading was impossible. For many years map reading in the desert had been conducted by the use of a sun compass. In its simplest form it consisted of a disc with bearing marked on it and a central spike. The vehicle had to be stopped for a reading to be taken; the user would then look to see where the spike had cast a shadow onto the disc then consult a book of tables that eventually would give them a position: all time-consuming and not ideal for fast-moving armoured warfare.

The introduction of the GPS must have been a godsend to vehicle commanders being able to see a constantly updated location on the screen, although there were some drawbacks, and in one of the multitude of books that followed, one of the senior commanders recounted a tale of the whole brigade driving flat out across the desert, with GPS keeping them on track, until just before midnight when they all ground to a halt for several minutes as the satellites were out of line with the GPS units. Once reconnected off went the charge once more.

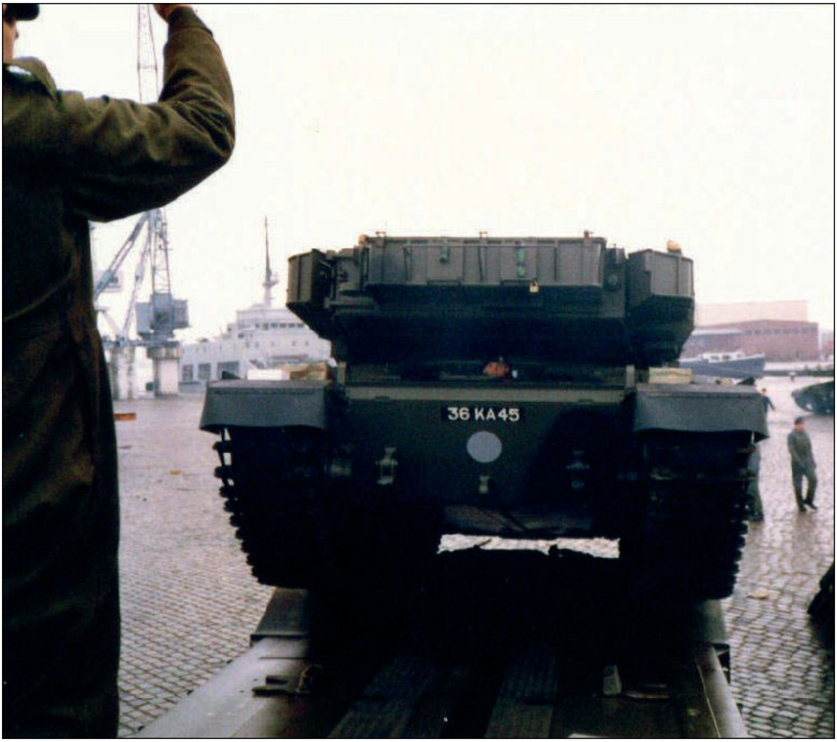
The fears about the Challenger's reliability, both mechanical and firepower, were shown to be false. From 20 February through to 4 March 1991 its availability percentage never fell below 83 percent and on 23 and 24 February it achieved 100 percent availability. 7th Armoured Brigade tanks covered a total of 300km per tank, which was not bad for a tank that was maligned for its reliability. Its firepower was also impressive. It was estimated that the Challengers had destroyed over 300 Iraqi tanks and countless light armoured vehicles and infantry positions, which was no more than its crews expected, for no loss of their own.

What they had not expected when they arrived in the Gulf was that one Challenger would enter the history books and become a legend within the Royal Armoured Corps. On 26 February 1991, a Challenger achieved the longest range confirmed kill of the war, destroying an Iraqi tank with an Armour-Piercing Fin-Stabilized Discarding-Sabot (APFSDS) round fired over a distance of 5,100 metres, the longest tank-on-tank kill shot recorded. The following statement from the gunner of that engagement explains exactly what took place that historic day:

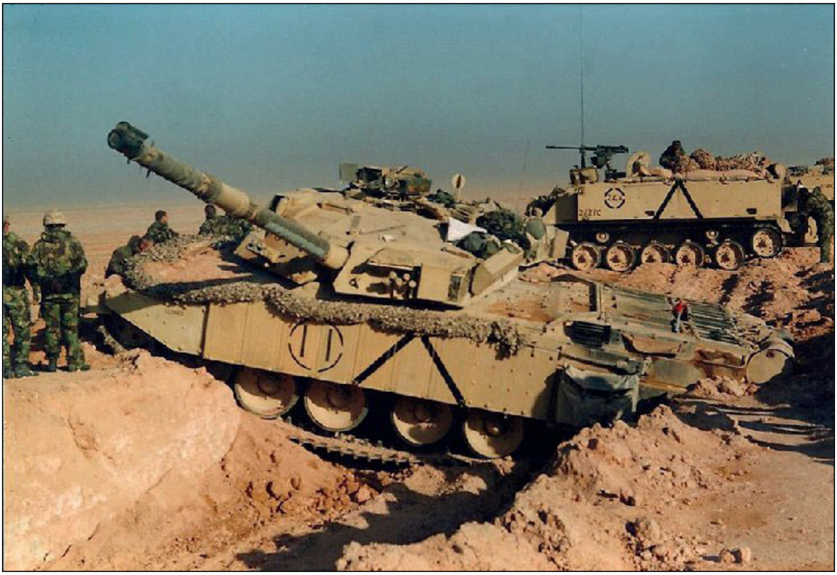
‘There seems to be some confusion about what happened and what shot etc. the range was just over 5100m. We had finished moving forward and had gone firm. I was scanning the horizon when picked up what I thought to be T62s across the valley. We had been shooting at whatever targets presented. I lased the target and was surprised by the range that came back, we started talking about having a go at the target amongst ourselves and the Colonel said ok to the shot. It was a normal fin round, and after lasing again I fine laid the ellipse [the shape of the computer created image that appears around a target when the IFCS (Improved Fire Control System) is used], onto the target and fired. It was a central hit just below the turret, as to whether the target was manned, or not I did not know.’



A good representation of the amount of kit and equipment that is carried in a tank when on operations. Sleeping bags are hung over the barrel to air, and other kit is draped over the vehicle. (Andrew Ingham)

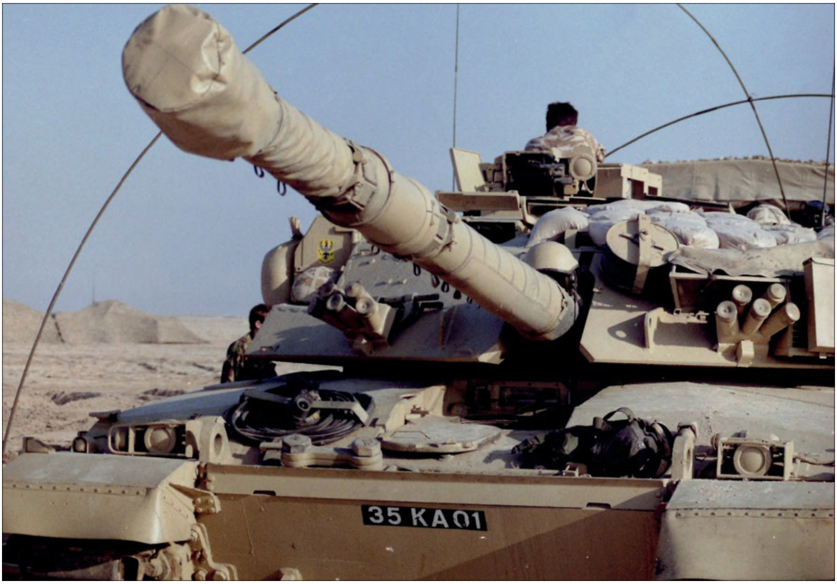


This shows that at one point the driver of Challenger, or similar vehicles, when loading or unloading, can see nothing but the sky. Once he has commenced loading he is totally under the control of the tank transporter driver and must obey his hand signals implicitly. (S Morse)

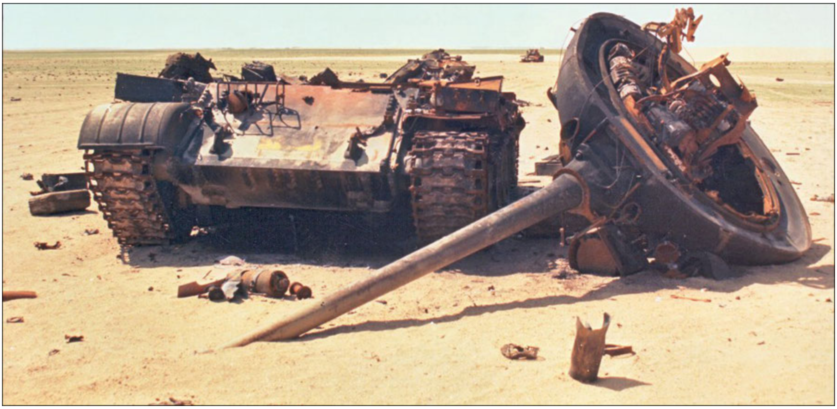


Challenger and FV432 during Operation Granby. Note the equipment around the turret top and the way the desert camouflage net is stored. The FV432 has appliqué armour added using bazooka plate, probably from the Chieftain AVREs that were in the Gulf. (Graeme Muir)

That record has still not been equalled, but as if that was not enough, he goes on to say, ‘however the shot I was really proud of was a T62 mover reversing up and out of a hull down position at about 1500m, and was hit with a HESH first round through the top of the turret, again fine laid without autolay [this is where the IFCS lays the gun for line and elevation by means of all the data from the computer].’



Gulf War Challenger. The rods running across the tank are fitted into brackets located on the hull. They are meant to ease the task of putting up the camouflage net. The poles are made of carbon fibre. When it worked it certainly did make it easier. (Image Copyright Neil Palmer)



It's not certain this was hit by a Challenger but the effect is very much the same and rather sobering. Russian-built/ designed tanks are well known for blowing their turrets off when hit. (Challenger Tank

Appreciation Society)

It would be fair to say that all in all the Challenger had proved its critics wrong and had performed magnificently. Although not all was rosy, the British Army learnt from its use and it was found that many of the issues that had been raised before, but put to one side, had raised their heads again, but this time under combat conditions. One of the biggest was the ergonomics, or lack of in-turret design, where crews may have had to stay on board for five or more days. These lessons, learnt in most cases during combat, were carried forward into the design of the Challenger 2.

To sum up it would be fair to look at two opposing comments from totally different sides of the fence, firstly Brigadier Patrick Cordingley, the commander of 7th Armoured Brigade, said afterward that, ‘Challenger is a tank built for combat and not competitions.’ The final one comes from a comment in a Dick Taylor Haynes manual on the Challenger, where he mentions that the Soviet military had obviously been studying the performance of Coalition equipment. Since Challenger would be engaged in combat against mostly Sovietbuilt equipment, they conclude that overall the Challenger was a better tank than the American M1 Abrams. Their reasons for this was that they deemed it not to need such a large logistic support train and because its fantastic levels of protection and overall survivability. Praise indeed from a potential enemy.

Challenger had it seems come of age and had shown what it could do when employed as it should have been, although the remarks about it not being a competition tank are a bit tenuous, as the M1 and Leopard have all seen action and taken part in CAT, at the end of the day it might be argued that they had more up-to-date equipment than the Challenger.

Operational deployment was not over for Challenger though; it would serve operationally on two more missions before being retired. Three years of horrific bloodshed and ethnic cleansing in Bosnia-Herzegovina had at its climax the Srebrenica Massacre in July 1995. Eight thousand Bosniak men and boys were murdered by the Bosnian Serb Army of Republika Srpska (VRS). As a direct result

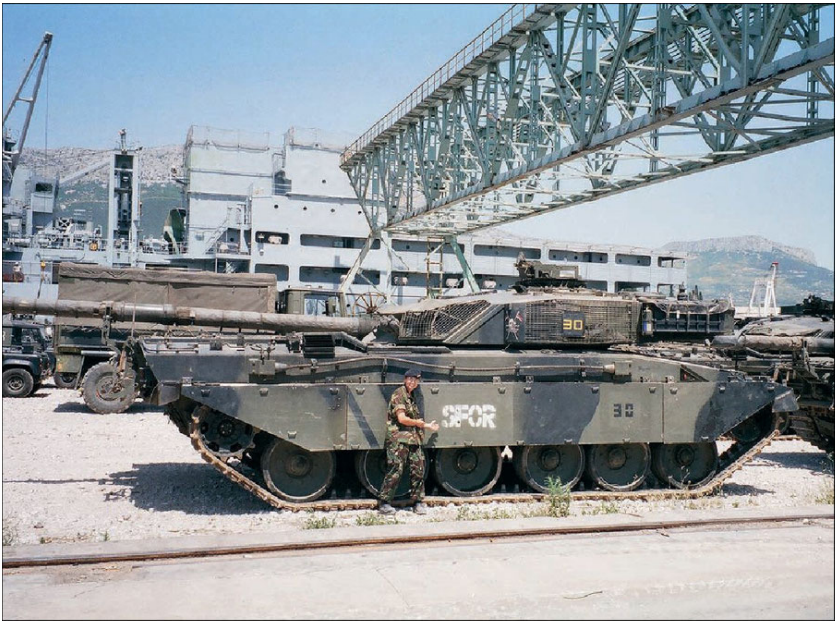
NATO led a bombing campaign against Republika Srpska. That, as well as a jointforces ground offensive in western Bosnia convinced the Bosnian Serb leadership to consider a negotiated settlement, resulting in the Dayton Agreement of December 1995. To enforce the agreement a NATOled peacekeeping force was immediately dispatched to the country. The force was known as Implementation Force (IFOR) and was tasked with enforcing the agreement in order to bring peace and stability to the region. The operation was known as Operation Joint Endeavour, but each country had its own name for their part. The United Kingdom sent troops under the codename Operation Resolute and as part of this various United Kingdom armoured regiments deployed with Challenger. Most did not deploy a full regiment; some of their troops were used to crew Combat Vehicle Reconnaissance (Tracked) (CVR (T)) or even act as infantry. Any doubts the warring factions might have had about their firepower and their willingness to use it were dispelled at a demonstration that took place on the Glamoc ranges in front of the military leader of all factions. IFOR displayed the awesome firepower available to it. This and the knowledge that NATO would deploy air strikes should the need arise left the leaders with plenty to think about.

34 KA 17
CHALLENGER 1
CLIMBING ON THIS VEHICLE IS STRICTLY FORBIDDEN

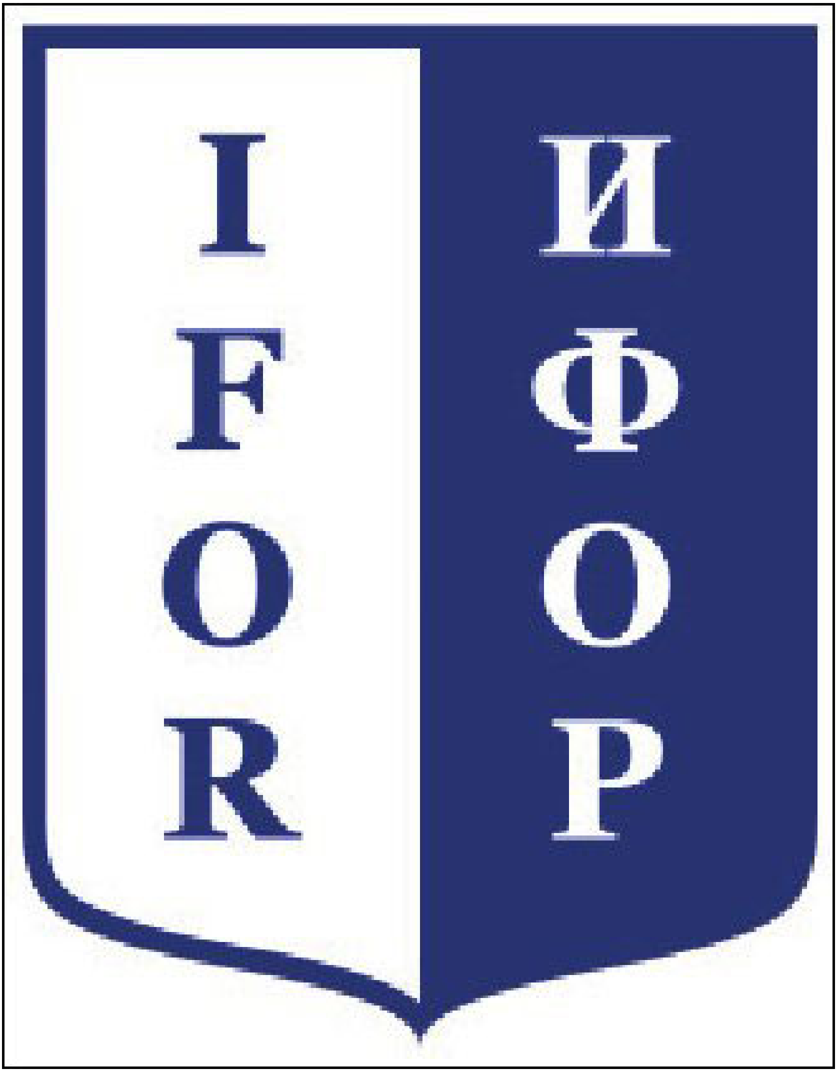
One of the two examples located in or near the Tank Museum at Bovington. This one is outside the former Junior Leaders Regiment Camp, Stanley Barracks. Visible on the right front bazooka plate is the vehicle's call sign and the famous red jerboa of 7th Armoured Brigade 'The Desert Rats'. (Paul Smith)

Challenger's role in this was more symbolic than aggressive, although the sight of 60 tons bearing down on you could not necessarily be described as peaceful. The tanks were involved in patrolling the areas of responsibility and resolving any potential conflict by sheer intimidation. The Royal Scots Dragoon Guards and later the King's Royal Hussars were based at Mrkonjik Grad; located in an old bus station was a varying amount of military hardware, including two Challengers from Regimental Headquarters.

They were used to patrol and brought back some interesting tales. On one such patrol it was reported that a T-55 tank was moving on exercise when it had no clearance. It had been told to stop the its activities and return to base but chose to ignore this, until it was coming up a track only to find a Challenger blocking its path. Discretion proved the better part of valour that day.



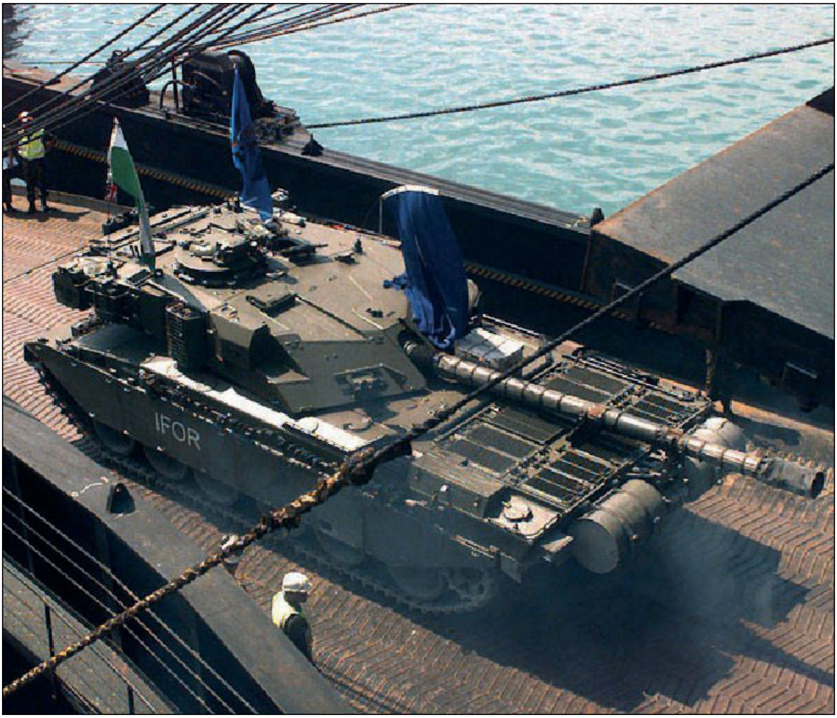
Challenger sporting the IFOR markings on the bazooka plates. The location seems to be the Croatian port of Split. (Challenger appreciation Society)



This is the Implementation Force badge that was worn by some British troops on deployment in Bosnia.

(Rob Griffin)

One event showed that perhaps people who do not work with tanks have no appreciation of them. The crew's Corrimec prefabricated accommodation overlooked the main road. One day a Serbian policeman was standing in the middle of it with a speed gun, and coming towards him flat out was a Challenger. He thought he had a speeding ticket to issue, but sadly for him the Challenger just kept coming and passed him in a cloud of dust, this being greeted with hoots of laughter from the troops watching.

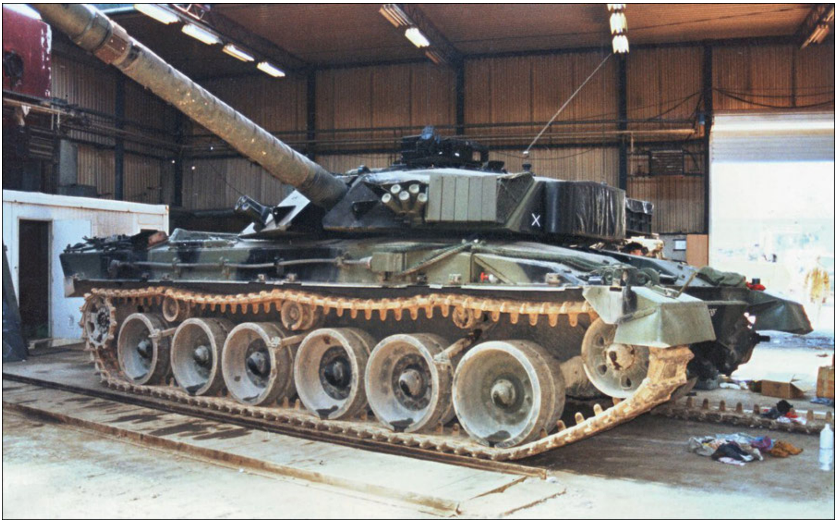


A good overhead view of Challenger either loading or unloading from the Roll-on/Roll-off (RORO) ship. Note the IFOR markings on the side, this could well be the Croatian port of Split. (Challenger Tank Appreciation Society)

More seriously, it is a great credit to the crews that Challenger did not have to fire in anger, their mere presence was enough. Although not fitted, the Gulf War armour packs were available in theatre and could have been used if required. IFOR handed over to Stabilisation Force (SFOR) on 20 December 1996.

That would be it for Challenger most people thought, for the deployment of heavy armour had been caused by circumstances that none could have predicited, but they were wrong. Although the next depolyment would not be as dramatic and was also the swansong for Challenger.

Despite claims from bodies such as the EU that Europe was at peace and had been since the end of the Second World War, the truth was a little different, for the next use of Challenger was in the southern Serbian province of Kosovo. It had a mixed population, of which the majority were ethnic Albanians. Until 1989 the region enjoyed a high degree of autonomy within the former Yugoslavia, when Serbian leader Slobodan Milošević altered the status of the region, removing its autonomy and bringing it under the direct control of Belgrade, the Serbian capital. The Kosovo Albanians opposed this with a non-violent separatist movement, employing widespread civil disobedience and creating parallel structures in education, medical care and taxation with independence as their ultimate goal. During 1998, open conflict between Serbian military and police forces and Kosovo Albanian forces resulted in the deaths of over 1,500 Kosovo Albanians and forced 400,000 people from their homes. The international community became gravely concerned about the escalating conflict, its humanitarian consequences, and the risk of it spreading to other countries. President Milošević's disregard for diplomatic efforts, aimed at peacefully resolving the crisis, and the destabilizing role of militant Kosovo Albanian forces was also of concern.



The Commanding Officer Royal Scots Dragoon Guards' Challenger located at Mrkonjik Grad bus station during its SFOR assignment. As can be seen some servicing is taking place: this tank was often out on patrol. (Rob Griffin)

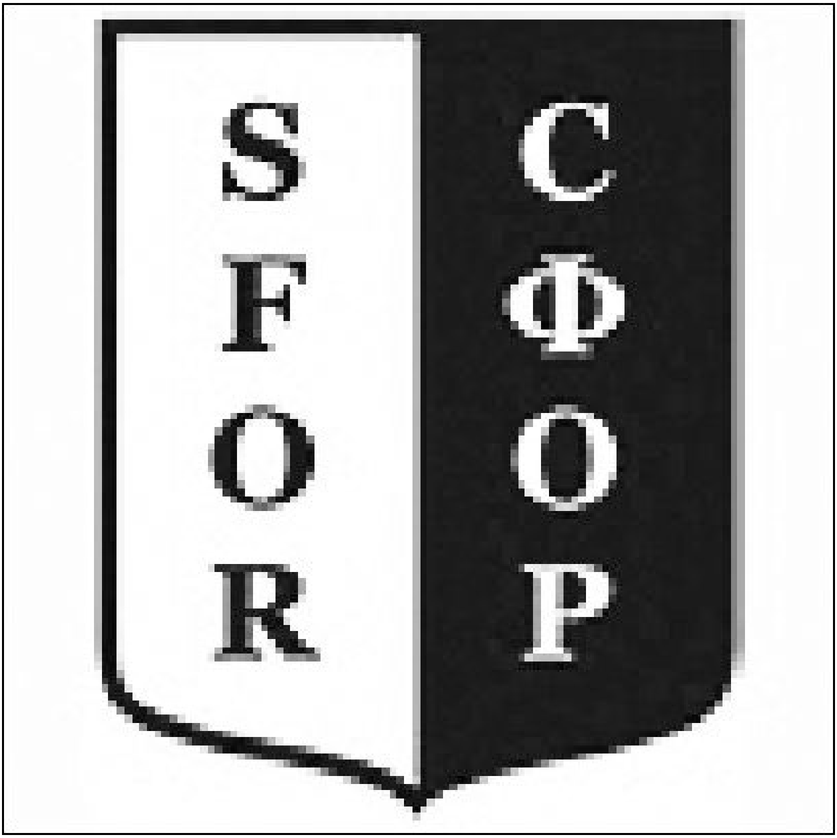
The international community applied political pressure on Milošević to no avail. Finally he was told that if he did not stop supporting the bloodshed NATO would intervene: the result was predictable. On 23 March 1999 Operation Allied Force commenced. This was the use of NATO airpower to attack and destroy Serbian forces in the hope of bringing an end to the conflict.

After two-and-a-half months of aerial bombardment NATO armour rolled into Kosovo. Leading the United Kingdom contingent on Operation Agricola (the name of the Roman general responsible for the conquest of most of Britain) were: two squadrons of Challengers from the King's Royal Hussars and it seems that there was fierce competition between them and the Parachute Regiment, but the cavalry won the day and were the first to enter the capital Pristina. Once established the Challengers commenced patrolling and doing what they had done earlier in Bosnia: creating a show of force to deter potential aggressors. The tanks carried a mixture of the basic

Challenger and were seen with the ERA armour on the glacis plate and the side armour packs. Painted on the sides were the letters KFOR in white, which stood for Kosovo Force, there were no significant incidents. As in Bosnia the sight and presence of the tanks was usually sufficient. The swansong for the Challenger came with the replacement of the King's Royal Hussars in August 1999 by the Queen's Dragoon Guards who were the second and last regiment to operate the Challenger in Kosovo, for when they were replaced it was by the Scots DG with Challenger 2.

One could say that it was not a very stunning end to Challenger's operational history but the feeling among crews who served there is that they saved lives just by being there and that was after all the aim of the deployment.

A pair of Challenger tanks on patrol during the period of IFOR. They certainly would provide a great deterrent. (Challenger Tank Appreciation Society)

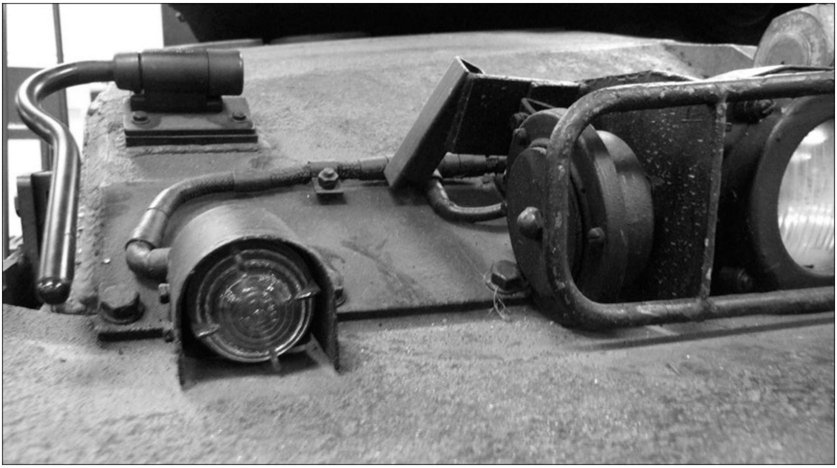


The SFOR badge that was worn by some, but not all, British units participating in Operation Lodestar, the United Kingdom contingent of the Stabilisation Force. (Rob Griffin)

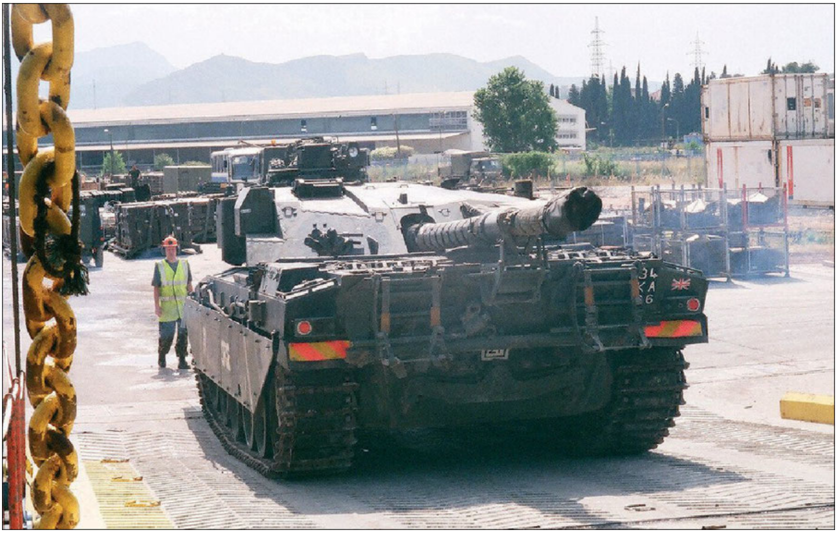
SFOR
ARMAGEDDON

A Challenger of the RDG in wintery conditions in Bosnia. The blade might come in useful in those conditions. (Ian Garden)

As has been mentioned the deployment to Kosovo was Challenger's last deployment. From 1998 it was replaced by Challenger 2 – technically this meant the United Kingdom now had three tanks that had been or were called Challenger. The reason for replacing the fleet is long and complicated but it does have some of its roots in the CAT 87 result. It was at last realized that no matter how much kit you add to a tank to bring it up to date, if the basic shell is past its shelf life then it is going to be nothing more than an expensive bodge job, which sadly Challenger was in the cold light of day. That, however, takes nothing away from the crews who in general loved it and its sterling performance in the Gulf War, but compared to the latest versions of M1 Abrams and the Leopard 2, it was a generation behind. While they could accurately fire on the move due to the gun linked to gyrostabilized sights, the Challenger was basically still using a system going back to Centurion, so something needed to be done. In January 1989 the government signed a deal with Vickers Defence Systems for £90 million to provide demonstrator vehicles based on a private venture Vickers had been working on to replace what came to be known as Challenger 1. Quite a shrewd move by Vickers who could see that its days were numbered and a replacement would be needed sooner than later. The demonstrators showed their potential and in 1991 the British MoD placed an order for 140 Challenger 2 tanks worth £520 million, this was followed by an order for 268. Full production began in 1993 and the tank was in service with the British Army from 1998, the last were delivered in 2002.



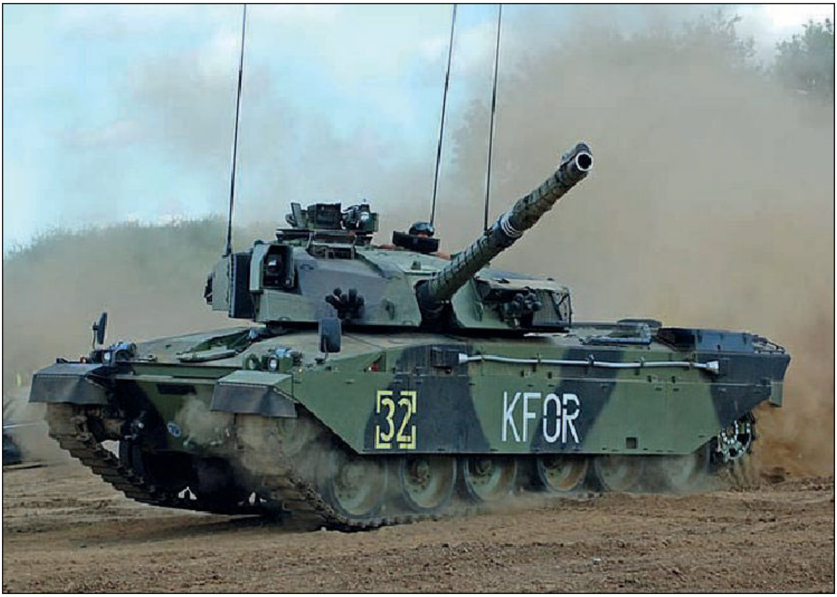
Close-up of the right headlight and side light cluster. Note the typical MoD issue sidelight lens with the four flanges on it. These are unique to the MoD. (Rob Griffin)



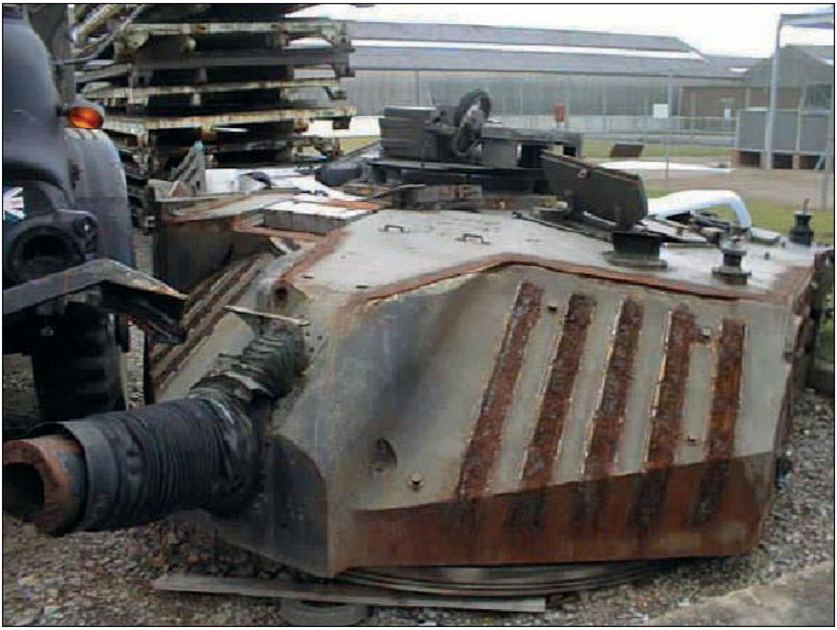
Challenger 1 either leaving or loading onto a RORO ship in what looks like the Croatian port of Split. Clearly visible are the brackets for the fuel drums. (David Giles)

CONCLUSION

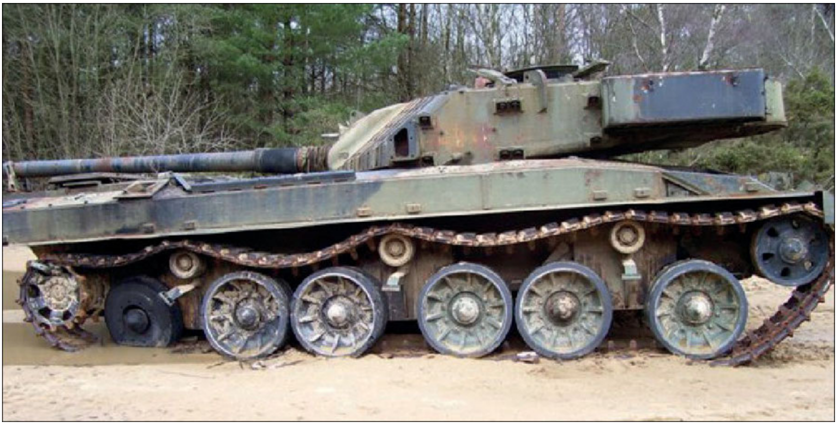
Once the Challenger 2 started to be issued to the regiments Challenger 1 was swiftly withdrawn, until no regiments were using it. Now came the problem of what to do with them all. Some tanks had only just been refitted at some cost, so using them as hard targets as had happened to some of the Chieftain fleet was not an option. Thankfully, after some hard negotiating, a great part of the fleet was sold as already mentioned to Jordan where they became the Al Hussein. Not all went, however, and of the approximately 427 hulls built 402 were listed as going to Jordan. Some have been lucky and now reside in museums such as Duxford, the external wing of the Imperial War museum. One is in private hands (minus its armour) and 35 KA 60 has an uncertain future, currently being the gate guard at 1st UK Division in Germany. One is in Bovington Tank Museum with another across the road at the old Junior Leaders Camp, Stanley Barracks. One other, for which no information is available, is at the Tank Museum, it is just a Challenger turret shell minus its armour. It is interesting because where it has been cut off it shows the locations for the mounting plates that once supported it. It may have fallen off a cliff edge in Bosnia, killing some or all of the crew, rather than bring it back into service the decision was made to destroy it.



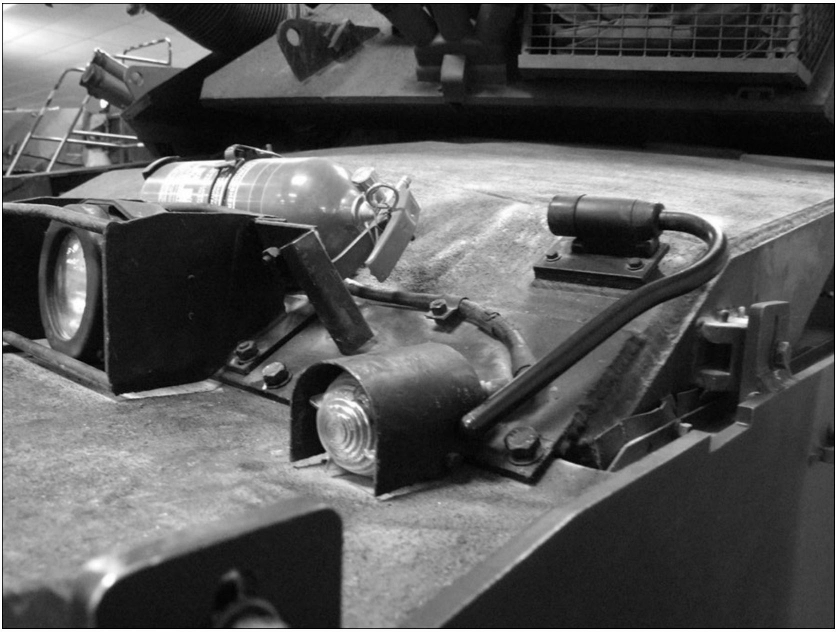
Challenger 1 showing how similar markings used for IFOR and SFOR were also used for the Kosovo operations. (Challenger Appreciation Society)



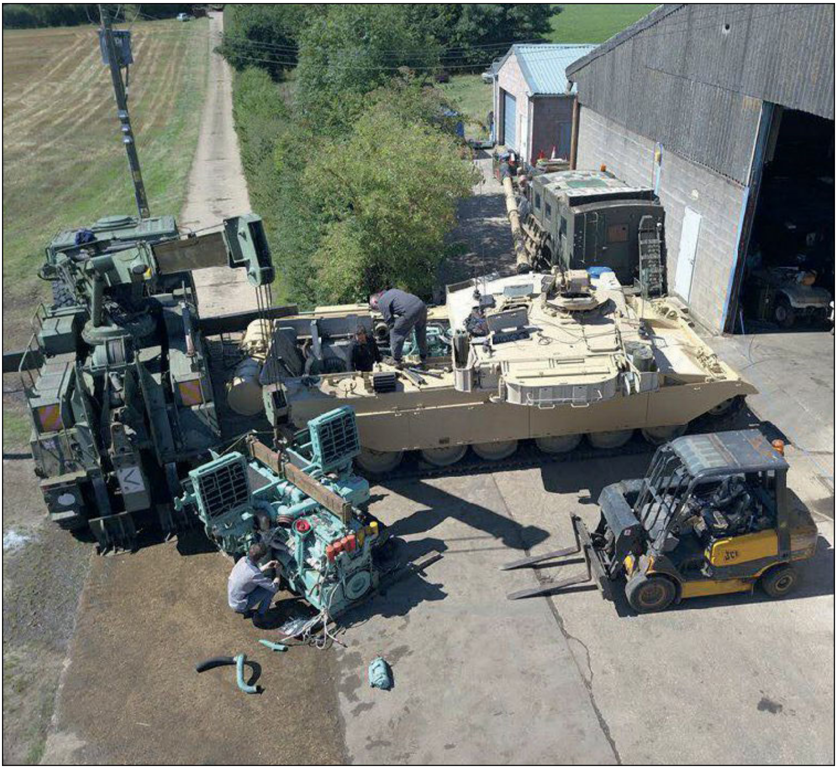
A Challenger 1 turret with the armour removed showing the weld marks from the spacers that supported the armour; this particular turret was eventually taken down to Lulworth ranges and dumped on the hull of Chieftain 900 for use as a target. (Rob Griffin)



Looking very sorry for itself is one of the prototype Shir Iran 2 tanks *that eventually morphed into Challenger 1. This one has had the turret armour removed and the lineage from Chieftain can be seen in the cast turret shape. This particular vehicle was photographed at the REME training area at Bordon before it was closed. (Rob Griffin)*



The red fire extinguisher stands out in this image. Now they are either green or a plastic green cover is provided to hide the colour. This vehicle also still retains the spring-loaded mirror arm, which very rarely ever sees a mirror fitted. (Rob Griffin)



This is the only Challenger in private ownership; it used to reside in the armour wing at Shrivenham but was bought by Andrew Baker. He has brought it back to life with a stunning rebuild and restoration. (Andrew Baker)

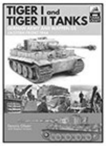
Of the prototypes six survive at various locations. One hull was used at the former REME training centre at Bordon in Hampshire as a recovery hulk, where the trainees would come out with a CRARRV, recover the hulk from its boggy home, then after a well-earned brew push it back into its hole ready for the next time.

Also in that area were a couple of nice Shir vehicles, but since the army has moved out the fate of those hulks and the many other interesting ones is a bit vague.

This then is the end of the Challenger story, a tank born almost as a second thought, failed miserably in competition, derided by many then achieved notoriety in the Gulf War, took part in several peace-keeping operations, finally to be sold to Jordan, while the survivors slumber on in retirement. Those who served on the Challenger will still say it was their favourite tank.

The aim of these innovative series is to provide modelmakers and enthusiasts with a new standard of primarily visual reference to both the full-size vehicles and their models, using detailed line drawings, plans and photographs, many in full colour. Each book is devoted to a famous military vehicle – chosen for its popularity as a modelling subject – but will range from main battle tanks to 4x4s.

TANK CRAFT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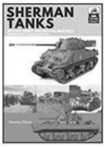
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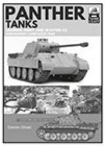
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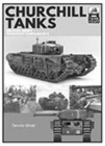
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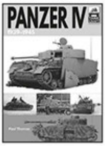
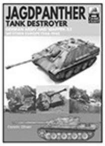



JAGDPANTHER
TANK DESTROYER

Tiger I and Tiger II: Tanks of the German Army and Waffen-SS
Eastern Front 1944

Sherman Tanks of the British Army and Royal Marines
Normandy Campaign 1944

Panther Tanks
Germany Army and Waffen-SS, Normandy Campaign 1944

Churchill Tanks
British Army, North-west Europe 1944–1945

Panzer IV
1939–1945

Jagdpanther Tank Destroyer
German Army and Waffen-SS, Western Europe 1944–1945

Panzer I & II
Blueprint for Blitzkrieg 1933–1941

T-34
Russia's Armoured Spearhead

Tiger I
German Army Heavy Tank, Southern Front, North Africa, Sicily and Italy, 1942–1945

Cromwell and Centaur Tanks
British Army and Royal Marines, North-west Europe 1944–1945

Centurion
Armoured Hero of Post-war Tank Battles

Sherman Tanks, US Army, North-western Europe, 1944–1945

Tiger I and Tiger II Tanks, German Army and Waffen-SS, The Last Battles in the West, 1945

T-54/55
Soviet Cold War Main Battle Tank

Tank Destroyer
Achilles and M10, British Army Anti-Tank Units, Western Europe, 1944–1945

FORTHCOMING

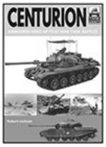
Panther: Germany Army and Waffen-SS
Defence of the West

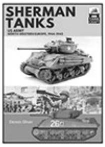
Chieftain
British Cold War Main Battle Tank

Challenger 1
British Main Battle Tank of the Gulf War

M1 Abrams
The US's Main Battle Tank in American and Foreign Service, 1981-2018

Tiger I: German Army Heavy Tank
Eastern Front, Summer 1943

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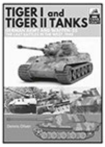
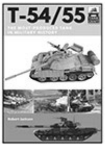
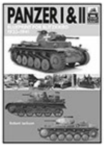
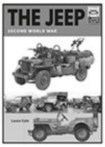

TIGER I and TIGER II TANKS


TANK DESTROYER
ACHILLES AND M10


LAND CRAFT



BREN GUN CARRIER

The Jeep
Second World War

M2/M3
American Half-tracks of the Second World War

Bren Gun Carrier
Britain's Universal War Machine

A wide range of kits and accessories attests to the long-standing popularity of these military vehicles as modelling subjects, while significant differences between variants offers opportunities to 'individualize' models, as is so well illustrated in these books by many archive and modern photographs.